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## **“MULTIPLICATIVE AND FRACTIONAL STRATEGIES WHEN JOURNALS ARE ASSIGNED TO SEVERAL SUB-FIELDS”**

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### **Abstract**

In many datasets, articles are classified into sub-fields through the journals in which they have been published. The problem is that many journals are assigned to a single sub-field, but many others are assigned to several sub-fields. This paper discusses a multiplicative and a fractional strategy to deal with this situation, and introduces a normalization procedure in the multiplicative case that takes into account differences in mean citation rates across sub-fields. The empirical part studies different aspects of citation distributions under the two strategies, namely: (i) the number of articles, (ii) the mean citation rate, (iii) the broad shape of the distribution, (iv) the characterization in terms of size- and scale-invariant indicators of high- and low-impact, and (v) the presence of extreme distributions, or distributions that behave very differently from the rest. It is found that, in spite of large differences in the number of articles according to both strategies, the similarity of the citation characteristics of articles published in journals assigned to one or several sub-fields guarantees that choosing one of the two strategies may not lead to a radically different picture in practical applications. Nevertheless, the evaluation of citation excellence through a high-impact indicator may considerably differ depending on that choice.

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## I. INTRODUCTION

Assume that we are given a hierarchical Map of Science that distinguishes between several aggregation levels, say between scientific sub-fields, disciplines, and fields from the lowest to the highest aggregation level. Each category at any aggregate level is assumed to belong to only one item at the next level, so that each sub-field belongs to a single discipline, and each discipline to a single field. Assume also that, as in the Thomson Scientific and Scopus databases, publications in the periodical literature are assigned to sub-fields via the journal in which they have been published. Many journals are assigned to a single sub-field, but many others are assigned to two, three, or more sub-fields. This is an important problem. For example, in the dataset used in this paper 42% of the 3.6 million articles published in 1998-2002 are assigned to two or more, up to a maximum of six sub-fields, where sub-fields are identified with the 219 Web of Science (WoS hereafter) categories distinguished by Thomson Scientific.

This paper investigates the practical implications arising from this situation. Two issues must be addressed. Firstly, the allocation of individual publications over the category set at each aggregate level. Secondly, the normalization procedure when closely related but heterogeneous sub-fields are brought together into some aggregate category.

We study two ways to solve the problem created when a journal is assigned to several sub-fields. The first follows a *fractional* strategy, according to which each publication is fractioned into as many equal pieces as necessary, with each piece assigned to a corresponding sub-field. Since each sub-field is assigned to a single discipline and the same rule applies at higher aggregate levels, the fractional assignment of individual papers to disciplines, and fields poses no additional problem, and the total number of publications at each level coincides with the total number of publications in the original dataset (This is the approach often followed in the literature; see *inter alia* Waltman *et al.*, 2011a). The second procedure follows a *multiplicative* strategy according to which each paper is wholly counted as many times as necessary in the several sub-fields to which it is assigned. In this

way, the space of articles is expanded as much as necessary beyond the initial size in what we call the *sub-field extended count*. When this strategy is applied at higher aggregate levels, we end up with different extended counts in which the total number of publications is always greater than the total number in the original dataset. However, for reasons explained below, the size of the extended counts decrease as we move upwards in the aggregation scheme.

Secondly, it is generally agreed that widely different citation practices at the sub-field level require some normalization when considering aggregate categories consisting of closely related but nevertheless heterogeneous sub-fields. Under the fractional strategy, the standard procedure is to use the sub-field fractional mean citation rate (MCR hereafter) as the normalization factor (see *inter alia* Waltman *et al.*, 2011a, in the context of average-based indicators of citation impact). However, as will be seen below, under the multiplicative strategy the normalization procedure is not obvious at all. To the best of our knowledge, this paper is the first to suggest a reasonable normalization procedure in this case.

The two strategies and their normalization procedures should be evaluated in terms of the properties they satisfy. However, quite apart from the *a priori* advantages that may make a strategy preferable to another one, it is important to verify the order of magnitude of the empirical differences that the alternative methods may bring. In particular, this paper studies the following three empirical issues.

1. Using size- and scale-invariant statistical techniques it is possible to focus solely on the shape of citation distributions independently of their size and MCR differences. Applying the Characteristic Scores and Scales (CSS hereafter) approach that satisfies these properties, Albarrán *et al.* (2011a) find that the partition of un-normalized citation distributions in the multiplicative case over three broad classes is strikingly similar across 219 sub-fields, as well as across other aggregate categories built according to several aggregation schemes. Thus, an important issue is whether or not the above regularities are maintained for the un-normalized distributions in the fractional case, as well as for the normalized distributions in both cases.

2. Using limited evidence that, nevertheless, spans broad areas of science, Radicchi *et al.* (2008) claim that normalization by sub-field means leads to a universal distribution (see also Glänzel, 2010). However, for the multiplicative case Albarrán *et al.* (2011a) present evidence against the universality claim across scientific sub-fields and other aggregate categories (see also Waltman *et al.* 2011b). In this paper we evaluate this issue in terms of the size- and scale-invariant indicators of high- and low-impact introduced in Albarrán *et al.* (2011b, c, d). The lack of universality will manifest itself through the presence of what we call *extreme distributions*, or citation distributions characterized by truly extreme indicator values.

3. It turns out that the broad shape of citation distributions, as well as the set of extreme distributions under both strategies is very similar indeed at all aggregate levels. These results seem to suggest that the choice between a multiplicative and a fractional strategy is of lesser importance. But this conclusion is not warranted. Even if citation distributions under both strategies may share a number of basic general characteristics, it is important for the user to isolate those categories at each aggregation level for which there are dramatic differences between the two strategies.

The rest of this paper consists of four Sections and three Appendices. Section II introduces the multiplicative and the fractional strategies, while Appendix I contains a numerical example that illustrates the normalization procedures under both strategies. Section III presents the data, and the empirical results about the similarities between the multiplicative and the fractional strategies, while Section IV is devoted to the differences between them. Appendix II contains some descriptive statistics at the individual category level, while the properties of the family of indicators used in the empirical part are summarized in Appendix III. Section V offers some concluding comments.

## II. THE TWO STRATEGIES

Suppose we have an initial citation distribution  $\epsilon = \{\epsilon_l\}$  consisting of  $N$  distinct articles, indexed by  $l = 1, \dots, N$ , where  $\epsilon_l$  is the number of citations received by article  $l$ . The total number of citations is denoted by  $\gamma = \sum_l \epsilon_l$ . There are  $S$  sub-fields, indexed by  $s = 1, \dots, S$ . Assume for the

moment that there is only one other aggregation level consisting of  $D < S$  disciplines, indexed by  $d = 1, \dots, D$ , as well as a rule that indicates the discipline to which each sub-field belongs. As indicated in the Introduction, the problem is that only about 58% of all the articles in our dataset are assigned to a single sub-field.

## II. 1. The Sub-field Level

Let  $X_l$  be the non-empty set of sub-fields to which article  $l$  is assigned, and denote by  $x_l$  the cardinal of this set, that is,  $x_l = |X_l|$ . Since, at most, an article is assigned to six sub-fields,  $x_l \in [1, 6]$ . In the first step in the multiplicative strategy each article is wholly counted as many times as necessary in the several sub-fields to which it is assigned. Thus, if an article  $l$  is assigned to three sub-fields, so that  $x_l = 3$ , it should be independently counted three times, once in each of the sub-fields in question, without altering the original number of citations in each case. Consequently, as long as  $x_l > 1$  for some article  $l$  and some area  $k$ , the total number of articles in what we call the *sub-field extended count*,  $N_{SF}$ , is greater than  $N$ . Formally, let  $N_s$  be the number of distinct articles, indexed by  $i = 1, \dots, N_s$ , which are assigned to sub-field  $s$ . Then,  $\mathbf{c}_s = \{c_{si}\}$  is the citation distribution in sub-field  $s$ , where  $c_{si}$  is the number of citations received by article  $i$ , and  $c_{si} = c_l$  for some article  $l$  in the original distribution. The sub-field extended count, **SF-count**, is the union of all sub-field distributions, namely,  $\mathbf{SF-count} = \cup_s \mathbf{c}_s$ , where  $N_{SF} = \sum_s N_s$ . For later reference, the MCR in sub-field  $s$ ,  $M_s$ , is defined by

$$M_s = (\sum_i c_{si}) / N_s. \quad (1)$$

In the fractional strategy, sub-field  $s$ 's citation distribution can be described by  $\mathbf{cf}_s = \{w_{si} c_{si}\}$ , where  $w_{si} = (1/x_l)$  for all  $s \in X_l$  and some article  $l$  in the initial distribution for which  $c_{si} = c_l$ . Therefore,  $\sum_{s \in X_l} w_{si} = 1$ . The fractional number of articles in sub-field  $s$  is  $n_s = \sum_i w_{si}$ , the citations received by each fractional article are  $w_{si} c_{si}$  and the fractional number of citations in sub-field  $s$  is  $\sum_i w_{si} c_{si}$ . Sub-field  $s$ 's MCR,  $m_s$ , is defined by

$$m_s = (\sum_i w_{si} c_{si}) / (\sum_i w_{si}). \quad (2)$$

By comparing expressions (1) and (2), it should be clear that the difference between the multiplicative and the fractional strategies amounts to a question of weighting. In the first strategy, the  $N_s$  distinct articles belonging to sub-field  $s$  receive a weight equal to one, while in the second strategy each of these articles is weighted by  $w_{si} = (1/x_i)$  for some article  $i$  in the initial distribution.

It should be noted that  $\sum_s n_s = \sum_s \sum_i w_{si} = \sum_i \sum_{s \in X_i} w_{si} = N$  and  $\sum_s c_s = \sum_s \sum_i w_{si} c_{si} = \gamma$ , that is, in the fractional strategy the total number of articles and citations in the original dataset are preserved at the sub-field level.

## II. 2. The Discipline Level

Since each sub-field belongs to a single discipline at the next aggregation level, there is no particular problem in associating the sub-field fractional numbers of articles and citations to the corresponding discipline. As a matter of fact, the discipline distribution in the fractional strategy,  $cf_d$ , is equal to the union of the corresponding sub-field distributions, that is,  $cf_d = \cup_s cf_s$ . Again, the number of articles and citations in a particular discipline,  $n_d = \sum_{s \in d} \sum_i w_{si}$  and  $\sum_{s \in d} \sum_i w_{si} c_{is}$ , may typically be fractional. However, the sum of these numbers over all disciplines necessarily coincides with the original ones:

$$\sum_d n_d = \sum_d \sum_{s \in d} \sum_i w_{si} = \sum_s \sum_i w_{si} = N,$$

and

$$\sum_d \sum_{s \in d} \sum_i w_{si} c_{is} = \sum_s \sum_i w_{si} c_{is} = \gamma.$$

In other words, in the fractional strategy the total number of articles and citations in the original dataset are preserved at the discipline level. Consequently, discipline  $d$ 's MCR,  $m_d = (\sum_{s \in d} \sum_i w_{si} c_{is}) / (\sum_{s \in d} \sum_i w_{si})$ , is equal to the weighted sum of its sub-fields MCRs, with weights equal to the proportion that the number of articles in each sub-field represents in the total number of articles in the discipline, that is,

$$m_d = \sum_{s \in d} \beta_s m_s, \quad (3)$$

where  $\beta_s = (\sum_i w_{si}) / (\sum_{s \in d} \sum_i w_{si})$ .

Instead, according to the multiplicative strategy, at the next aggregate level each article is wholly counted as many times as necessary given the several disciplines to which it belongs. Formally, for any article  $l$ , let  $Y_l$  be the non-empty set of disciplines to which article  $l$  is assigned, and let  $y_l = |Y_l|$  be the cardinal of this set. At the discipline level, article  $l$  is counted  $y_l$  times with  $c_l$  citations each time. Of course,  $y_l \leq x_l$  for all  $l$ . Let  $N_d$  be the number of distinct articles in discipline  $d$ , and denote by  $\mathbf{c}_d = \{c_{dj}\}$  the citation distribution in discipline  $d$ , where  $c_{dj}$  is the number of citations received by article  $j = 1, \dots, N_d$ . Thus, there must exist at least one sub-field  $s$  belonging to  $d$ , some  $i = 1, \dots, N_s$ , and some article  $l$  in the original distribution such that  $c_{dj} = c_{si} = c_l$ . The *discipline extended count*, ***D-count***, is the union of all discipline distributions, namely,  $\mathbf{D-count} = \bigcup_d \mathbf{c}_d$ , where  $N_D = \sum_d N_d$  is the number of articles in the discipline extended count. Since  $D < S$ , as long as there exists some  $l$  and some  $d$  for which  $y_l < x_b$ ,  $N_d < \sum_{s \in d} N_s$  and  $N_D < N_{SF}$ . The MCR of distribution  $\mathbf{c}_d$ ,  $M_d$ , is defined by

$$M_d = \gamma_d / N_d, \quad (4)$$

where  $\gamma_d = \sum_j c_{dj}$  is the total number of citations in  $\mathbf{c}_d$ . Since the link between the two levels is broken,

$$M_d \neq \sum_{s \in d} \alpha_s M_s,$$

where  $\alpha_s = N_s / N_d$  and the mean  $M_s$  and  $M_d$  are defined in equations (1) and (4), respectively. However, there is an expression similar to (3) for  $M_d$ . To show this, we need to introduce some more notations. For any  $d \in Y_b$ , let  $X_{dl} \subseteq X_l$  be the non-empty set of sub-fields in  $X_l$  that belong to discipline  $d$ , and let  $x_{dl} = |X_{dl}|$  be the number of sub-fields in  $X_{dl}$ . Finally, for any  $s$ , let  $\mathbf{c}'_s = \{v_{si}, c_{si}\}$  be a new sub-field distribution where

$$v_{si} = 1/x_{ld} \text{ for all } s \in X_{ld}$$

so that  $\sum_{s \in X_{ld}} v_{si} = 1$ . It turns out that the number of articles and citations in the union of the new sub-field distributions,  $\bigcup_{s \in d} \mathcal{C}'_s$ , coincides with  $N_d$  and  $\gamma_d$  respectively. To see this, for any article  $l$  assigned to some sub-field  $s$  that belongs to some discipline  $d$ , we must consider two possibilities depending on the cardinality of  $x_r$ .

(i) Assume that  $x_l = 1$ , so that  $X_l = \{s\}$  is a singleton. Then, there exists some  $i = 1, \dots, N_s$  for which  $c_{si} = c_r$ . Since sub-field  $s$  belongs to discipline  $d$ , we have:  $Y_l = \{d\}$ . Then there exists a single article  $j = 1, \dots, N_d$  with  $c_{dj} = c_{si} = c_r$ . On the other hand,  $X_{ld} = X_b$  and  $y_l = x_{ld} = x_l = 1$ , so that  $v_{si} = 1/x_{ld} = 1$ , and  $v_{si} c_{si} = c_r$ . Therefore, article  $l$  is counted once in  $\bigcup_{s \in d} \mathcal{C}'_s$  and receives  $c_l$  citations.

(ii) Assume that  $x_l > 1$ , so that  $X_l$  consists of several sub-fields. Note that, for every  $s \in X_b$ , there exists some  $i = 1, \dots, N_s$  for which  $c_{si} = c_r$ . Next, we must consider three cases. (ii.a) If all sub-fields in  $X_l$  belong to a single discipline, then  $Y_l = \{d\}$  with  $y_l = 1$ , and there exists a single  $j = 1, \dots, N_d$  such that  $c_{dj} = c_{si} = c_l$  for every  $s \in X_r$ . On the other hand,  $X_{ld} = X_l$  with  $x_{ld} = x_b$ .  $\sum_{s \in X_{ld}} v_{si}$  is always equal to one, and  $\sum_{s \in X_{ld}} v_{si} c_{si} = \sum_{s \in X_{ld}} (c_l/x_{ld}) = c_r$ . Therefore, as before, article  $l$  is counted once in  $\bigcup_{s \in d} \mathcal{C}'_s$  and receives  $c_l$  citations. (ii.b) If each sub-field in  $X_l$  belongs to a different discipline, then  $y_l = x_b$  and article  $l$  is counted  $y_l$  times at the discipline level with  $c_l$  citations each time. In particular, for each  $d \in Y_l$  there exists some  $j = 1, \dots, N_d$  with  $c_{dj} = c_r$ . On the other hand, for each  $d \in Y_l$  we have that  $X_l$  is a singleton with  $x_{ld} = 1$ , so that  $\sum_{s \in X_l} v_{si} = \sum_{d \in Y_l} \sum_{s \in X_{ld}} v_{si} = x_b$  and  $v_{si} c_{si} = c_l$  for each  $s \in X_r$ . Therefore, article  $l$  will be counted  $y_l = x_l$  times in  $\bigcup_{s \in d} \mathcal{C}'_s$ , each time receiving  $c_l$  citations. (ii.c) If some sub-fields in  $X_l$  belong to a certain discipline and some others belong to one or several more disciplines, then  $1 < y_l < x_l$  and article  $l$  is counted  $y_l$  times at the discipline level with  $c_l$  citations each time. On the other hand,  $X_l = \bigcup_{d \in Y_l} X_{ld}$  with  $x_l = \sum_{d \in Y_l} x_{ld}$ . In this case,  $\sum_{s \in X_{ld}} v_{si} = 1$  for each  $d \in Y_b$ , so that  $\sum_{s \in X_l} v_{si} = y_l$ . Therefore, article  $l$  is counted  $y_l$  times in  $\bigcup_{s \in d} \mathcal{C}'_s$ , each time receiving  $\sum_{s \in X_{ld}} v_{si} c_{si} = c_l$



citations. Thus, in the previous example with  $x_l = 3$  for some  $l$ , assume that the first two sub-fields belong to one discipline whereas the third belongs to another discipline, so that  $y_l = 2$ . In the multiplicative strategy, article  $l$  is counted three times at the sub-field level but only twice at the discipline level.

As announced above, we conclude that the total number of citations in  $\bigcup_{s \in d} \mathcal{C}'_s$  is equal to  $\gamma_d$  and the total number of articles,  $\sum_{s \in d} N'_s$ , where  $N'_s = \sum_i v_{si}$  is the possibly fractional number of articles in the new sub-field distribution  $\mathcal{C}'_s$ , is equal to  $N_d$ . Thus, we can obtain an expression analogous to expression (3), namely:

$$\begin{aligned} M_d &= (\sum_{s \in d} \sum_i v_{si} c_{si}) / (\sum_{s \in d} \sum_i v_{si}) = (\sum_{s \in d} [N'_s [\sum_i v_{si} c_{si} / N'_s]]) / (\sum_{s \in d} \sum_i v_{si}) \\ &= \sum_{s \in d} (N'_s / N_d) M'_s, \end{aligned}$$

where  $M'_s$  is the new sub-field  $s$ 's MCR defined by

$$M'_s = (\sum_i v_{si} c_{si}) / (\sum_i v_{si}), \quad (5)$$

By comparing expressions (1) and (5), it should be clear that the difference between the multiplicative strategy at the sub-field and the discipline level amounts to a question of weighting. In the first case, the  $N_s$  distinct articles belonging to sub-field  $s$  receive a weight equal to one, while in the second case an article  $l$  in the original distribution belonging to a new sub-field  $s$  and discipline  $d$  is weighted by the inverse of the number of sub-fields belonging to discipline  $d$ , namely, is weighted by  $v_{sl} = (1/x_{ld})$ , so that the MCR at the discipline level is seen to be equal to the weighted sum of its new sub-fields MCRs, with weights equal to the proportion that the number of articles in each new sub-field represents in the total number of articles in the discipline.

### II. 3. Normalization Procedures

As indicated in the Introduction, whenever possible we must normalize aggregate distributions, say at the discipline level, taking into account differences in citation practices across their sub-fields. In the fractional case, normalization is straightforward. The normalized distribution

of sub-field  $s$ ,  $\mathcal{f}_s$ , is simply equal to the original one where each fractional article is divided by the fractional sub-field mean  $m_s$  defined in equation (2). Discipline  $d$ 's normalized distribution,  $\mathcal{f}_d$ , is simply equal to the union of the corresponding  $\mathcal{f}_s$  distributions. Thus,  $\mathcal{f}_s = \{\mathcal{f}_s/m_s\} = \{(w_{si} c_{sj})/m_s\}$  for all  $s$  belonging to  $d$ , and  $\mathcal{f}_d = \bigcup_{s \in d} \mathcal{f}_s$ . Of course, the MCRs of distributions  $\mathcal{f}_s$  and  $\mathcal{f}_d$  for all  $s$  and all  $d$  are equal to one.

Discipline  $d$ 's normalized distribution in the multiplicative case is  $\mathcal{z}_d = \{z_{dj}\}$ , where

$$z_{dj} = c_{dj} \sum_{s \in X_{ld}} (v_{si}/M'_s) = (c_l/x_{ld}) \sum_{s \in X_{ld}} (1/M'_s),$$

and  $M'_s$  is defined in expression (5). For each  $s$  belonging to  $d$ , let  $\mathcal{z}'_s = \{c'_s/M'_s\} = \{(v_{si} c_{sj})/M'_s\}$  be the new sub-field normalized distribution. As before, the MCR of the normalized distribution  $\mathcal{z}_d$  is seen to be equal to the MCR of the union  $\bigcup_{s \in d} \mathcal{z}'_s$ . Of course, the MCRs of distributions  $\mathcal{z}'_s$  and  $\mathcal{z}_d$  for all  $s$  and all  $d$  are equal to one. (Appendix I in the Working Paper version of this paper, Herranz and Ruiz-Castillo, 2011a, –HR-C hereafter– contains a numerical example in which the two strategies and the corresponding normalization procedures are illustrated).

To understand the procedure at higher aggregate levels, say for  $F$  fields with  $F < D$ , indexed by  $f = 1, \dots, F$ , it suffices to redefine  $Y_l$  as the non-empty set of fields to which article  $l$  is assigned, and  $X_{jf}$  as the non-empty set of sub-fields in  $X_l$  that belong to field  $f$  in  $Y_l$ . Then, as before, if  $x_{jf} = |X_{jf}|$  is the number of sub-fields in  $X_{jf}$ , then for any  $s$  let  $\mathcal{c}''_s = \{u_{si} c_{si}\}$  be a new sub-field distribution where  $u_{si} = 1/x_{jf}$  for all  $s \in X_{jf}$ , so that  $\sum_{s \in X_{jf}} u_{si} = 1$ . The new fractional number of articles in sub-field  $s$  is equal to  $N''_s = \sum_i u_{si}$ , and the new MCR of distribution  $\mathcal{c}''_s$  is denoted by  $M''_s$ . The number of distinct articles in the field distribution  $\mathcal{c}_f$ ,  $N_f$ , is seen to be equal to  $\sum_{s \in f} N''_s$ , and the MCR of  $\mathcal{c}_f$ ,  $M_f$ , is equal to the weighted sum of its new sub-fields MCRs, with weights equal to the proportion that the number of articles in each new sub-field represents in the total number of articles in the field:

$$M_f = \sum_{s \in f} (N''_s/N_f) M''_s.$$

The *field extended count*, ***F-count***, is the union of all discipline distributions, namely,  $\mathbf{F-count} = \cup_f c_f$  where  $N_F = \sum_f N_f$  is the number of articles in the field extended count with  $N < N_F < N_D < N_{SF}$ . From this point, normalization proceeds as in the discipline case. Eventually, when we reach the maximum aggregation level the weighting system in the multiplicative strategy coincides with the one in the fractional strategy.

## II. 4. *A priori* Evaluation of Both Procedures

The preservation of the total number of papers and citations at each aggregate level in the fractional case, lends this strategy an aura of “normalcy”. However, the fractional strategy is not beyond criticism. Firstly, assume that there are two articles assigned to a certain sub-field. The first article is only assigned to this sub-field, while the second is also assigned to other sub-fields. Why should the weights associated to both articles in computing any statistic –such as the MCR, for example– be entirely different as implied by the fractional strategy? It can be argued that in the study of any sub-field all articles should count equally regardless of the role some of them may play on other sub-fields.<sup>1</sup> Of course, as we have seen, at the lowest aggregation level this leads to an artificially large sub-field extended count. However, this is not that worrisome in the sense that, since this strategy does not create any interdependencies among the sub-fields involved, it is still possible to separately investigate every sub-field in isolation, independently of what takes place in any other sub-field. Similarly, consider a situation in which two articles are assigned to the same discipline, but one is assigned only to a single sub-field, and hence to only that discipline, and the other is assigned to several sub-fields and possibly to other disciplines. In the fractional strategy the second article will be weighted by  $1/x_b$  while in the new sub-field according to the multiplicative strategy it will be weighted only by  $1/x_{ld}$  where  $x_{ld} < x_b$ . Consequently, in this discipline the second article’s citations in the multiplicative approach will be  $c_b$  while in the fractional approach will be

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<sup>1</sup> We would like to take this opportunity to correct the idea that “...fractionally assigned articles have a much smaller chance of occupying the upper tail of citation distributions than articles assigned to a single WoS category” (Albarrán *et al.*, 2001a, p. 389). Fractionally assigned articles would play a smaller role than articles assigned to a single sub-field, but they would have the same chance of occupying the upper tail of citation distributions.

$\sum_{s \in X_{ld}} w_{si} c_{si} = \sum_{s \in X_{ld}} (1/x) c_l = (x_{ld}/x) c_l$ . Why should the role of the second article be diminished as much as demanded by the fractional strategy, when in the study of any discipline all articles should count equally regardless of the role some of them may play in other disciplines? This is the reason why, in their study of citation distributions, Albarrán *et al.* (2011a) follow a multiplicative strategy at all aggregate levels.

Secondly, assume without loss of generality that we want to evaluate the citation impact of different research units in a certain sub-field (as before, a similar argument can be offered when the evaluation is performed at any other aggregate level). In the computation of any citation impact indicator a fractional strategy reduces the role of articles published in journals assigned to several sub-fields. Therefore, this strategy would hurt relatively more those research units with highly cited articles of this type. It can be argued that, from a normative point of view, this implication distorts the evaluation of research units in a given sub-field. This is the additional reason why, in their comparison of citation impact performance in a partition of the world into three geographical areas (the U.S., the European Union, and the rest of the world), Herranz and Ruiz-Castillo (2011b, c, d, e) also follow a multiplicative strategy.

Admittedly, others will see the issue differently. However, we may all agree that knowing the empirical consequences of following the two strategies is worthwhile investigating. This is the topic explored in the rest of the paper.

### III. DATA, AND SIMILARITIES BETWEEN THE MULTIPLICATIVE AND THE FRACTIONAL STRATEGIES

#### III. 1. The Data

Since we wish to address a homogeneous population, in this paper only research articles or, simply, articles are studied. The dataset consists of about 3.6 million articles published in 1998-2002, and the 28 million citations they receive after a common five-year citation window for every year,

namely, citations received from 1998 to 2002 for articles published in 1998, up to 2002 to 2006 for articles published in 2002.

As indicated in the Introduction, sub-fields are identified with the 219 WoS categories distinguished by Thomson Scientific. To facilitate the reading of results, it will be useful to classify these sub-fields into other aggregate categories. The difficulty, of course, is how to construct a Map of Science –a question that is known to have no easy answer. Among the many alternatives, Albarrán *et al.* (2011a) focus on the schemes recommended by Tijssen and van Leeuwen (2003) and Glänzel and Schubert (2003). Borrowing from these two schemes with the aim of maximizing the possibility that a power law represents the upper tail of each of the corresponding citation distributions, Albarrán *et al.* (2011a) constructed a third scheme consisting of 80 intermediate categories, or disciplines, and 19 fields. The existence of a power law cannot be rejected in 59 of 80 disciplines and 16 of 19 fields. For our purposes, we separate Computer Sciences from Engineering to work with a total of 20 fields.<sup>2</sup>

Table 1 provides the number of articles in the different extended counts. The sub-field extended count has more than 5.7 million articles, or 57.1% more than the number of articles in the original dataset. Disciplines, and fields lead to extended counts about 47%, and 34% larger than the original dataset.

**Table 1 around here**

### **III.2. Characteristics of the Shape of Citation Distributions**

We know that the broad shapes of un-normalized citation distributions in the multiplicative case are highly skewed and strikingly similar at all aggregation levels (see *inter alia* Schubert *et al.*, 1987, Seglen, 1992, Albarrán and Ruiz-Castillo, 2011, and Albarrán *et al.*, 2011a). Therefore, it is very important to verify whether this is also the case for the original distributions in the fractional

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<sup>2</sup> We should make clear that it is not claimed that this aggregation scheme provides an accurate representation of the structure of science. It is rather a convenient simplification or a realistic tool for the discussion of the aggregation issue.

strategy at the sub-field level, and for the normalized distributions according to both strategies at all aggregate levels.

Size- and scale-independent descriptive tools permit us to focus on the shape of distributions. In particular, the CSS approach, pioneered by Schubert *et al.* (1987) in citation analysis, permits the partition of any distribution of articles into five convenient classes according to the citations they receive. Denote by  $s_1$  the MCR; by  $s_2$  the mean of articles above  $s_1$ , and by  $s_3$  the mean of articles above  $s_2$ . The first category includes articles without citations. As for the remaining four, articles are said to be *poorly cited* if their citations are below  $s_1$ ; *fairly cited* if they are between  $s_1$  and  $s_2$ ; *remarkably cited* if they are between  $s_2$  and  $s_3$ , and *outstandingly cited* if they are above  $s_3$ .

By way of example, the individual information for the un-normalized distributions at the sub-field level according to the fractional strategy is in Table A in Appendix II (To save space, the individual information for the normalized distributions according to both strategies is available on request. On the other hand, the individual information for the un-normalized distributions at all aggregate levels according to the multiplicative strategy is in Table D in the Appendix in the Working Paper version of Albarrán *et al.*, 2011a). For the partition of citation distributions at the sub-field level into three broad classes –comprising categories 1+2, 3, and 4+5– the relevant information at different aggregate levels according to both strategies is in Table 2.

### **Table 2 around here**

According to Albarrán *et al.* (2011a), approximately 69% of all articles in the multiplicative case at the sub-field level receive citations below the mean and account for about 21% of all citations, while articles with a remarkable or outstanding number of citations represent about 10% of the total, and account for approximately 45% of all citations. This is exactly what we find for the un-normalized distributions in the fractional case at the sub-field level, as well as for the normalized distributions according to both strategies at the discipline and field levels. In brief, the partition into three broad citation categories is, approximately, 69/21/10 of all articles, accounting for 34/21/45 of all citations.

However, when we move inside the union of categories 1 and 2 and categories 4 and 5 differences across categories at all aggregation levels become much larger. For example, taken separately, categories 1 and 2 at the sub-field level in the fractional case represent on average 23.6% and 44.7% of all articles, with large standard deviations equal to 12.3 and 11.3, respectively.<sup>3</sup> Perhaps this is partly due to the fact that we have taken a common five-year citation window for all sub-fields in spite of the large differences in the time that it takes for citation processes to reach a given degree of completion. Be that as it may, since the size of both categories has a strong negative correlation the union of the two categories in Table 2 has a very small standard deviation. Something similar takes place for categories 4 and 5. At the sub-field level in the fractional case, these two categories represent 7.0% and 3.2% of all articles with standard deviations equal to 1.1 and 0.6 and, therefore, coefficient of variations equal to 0.15 and 0.20, respectively.<sup>4</sup> However, as observed in Table 2, these measures of dispersion for the union of categories 4 and 5 are 1.6 and 0.16. As far as the proportion of citations is concerned, the union of categories 4 and 5 account for 44.7% of the total with a coefficient of variation of 0.09, while category 5 alone accounts for 22.4% of the total with a coefficient of variation of 1.12.

Similar phenomena are observed at higher aggregate levels. Thus, dispersion statistics formally reveal that the universality of citation distributions breaks down at both the lower and the upper tails at all aggregation levels. This conclusion contrasts with the more optimistic view offered by Radicchi *et al.* (2008) with a methodology that does not explain whether a multiplicative or a fractional strategy has been used, omits articles without citations, examines distributions at a limited set of points and, above all, covers only 14 of the 219 sub-fields. In addition, Albarrán *et al.* (2011a) find considerable differences in the power law characteristics of 140 un-normalized sub-field distributions and a variety of un-normalized aggregate distributions in the multiplicative case. Thus, the lack of universality is

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<sup>3</sup> The corresponding figures for the multiplicative strategy are 24.7% and 43.9% of all articles, with standard deviations equal to 13.9 and 12.5 (see the Working Paper version of Albarrán *et al.*, 2011a, p. 17).

<sup>4</sup> The corresponding figures for the multiplicative strategy are 6.8% and 3.2% of all articles, with standard deviations equal to 1.1 and 0.7, and coefficients of variation equal to 0.16 and 0.22 (see the Working Paper version of Albarrán *et al.*, 2011a, p. 17).

particularly apparent at one key segment of citation distributions: the tip of the upper tail, or the place where citation excellence resides. The estimation of power laws is beyond the scope of this paper. However, in the remainder of this Section we pursue the study of the lack of universality by detecting the presence of extreme distributions, or citation distributions characterized by extreme values of certain indicators.

### III.3. High- and Low-impact Citation Indicators

As we have seen, citation distributions are highly skewed in the sense that a large proportion of articles receive none or few citations while a small percentage of them account for a disproportionate amount of all citations. An important consequence is that average-based indicators may not adequately summarize these distributions for which the upper and the lower part are typically very different. This leads to the idea of using two indicators to describe any citation distribution: a *high-* and a *low-impact measure* defined over the set of articles with citations above or below a *critical citation line* (CCL hereafter). In the first empirical application of this methodology, Albarrán *et al.*, (2011c) use a family of high- and low-impact indicators, briefly introduced in Appendix III, that satisfies a number of desirable properties. In this paper, we use one high- and one low-impact indicator, denoted by  $H$  and  $L$ , which are members of these families. The reason for using these indicators is twofold.

Firstly, while average-based measures are silent about the distributive characteristics on either side of the mean,  $H$  and  $L$  are sensitive to the citation inequality in the sense that an increase in the coefficient of variation increases both of them. Secondly, it is well known that wide differences in publication and citation practices give rise to wide differences in size and MCR across sub-fields. However, in this paper we are interested in studying the presence of distributions that are very different from the rest abstracting from differences in those two characteristics. Fortunately,  $H$  and  $L$  allow us to pursue this aim because they are size- and scale-invariant, namely, the value they take is invariant under replications and scalar multiplication of citation distributions.

### III.4. Extreme Distributions



Individual information about high- and low-impact levels according to the  $H$  and  $L$  indicators in the multiplicative and the fractional case at the sub-field level is included in Table B in Appendix II. The CCL is always fixed at the 80<sup>th</sup> percentile of all citation distributions.

Starting with the low-impact phenomenon, it is observed that the mean and the median of the distribution of  $L$  at the sub-field level in the multiplicative case practically coincide –the values are 0.46 and 0.45– the standard deviation is small and equal to 0.05. Only 32 out of 219 sub-fields are slightly above a value equal to  $0.46 + 0.05 = 0.51$ , and 27 below a value equal to  $0.46 - 0.05 = 0.41$ . In brief, only four distributions with  $L$  greater than or equal to 0.60 ((i) Engineering, Petroleum; (ii) Engineering, Marine; (iii) Transportation Science & Technology; (iv) Materials Science, Characterization & Testing), and Behavioral Sciences with  $L$  equal to 0.33 can be considered as mildly extreme. The correlation coefficient of  $L$  values according to the two strategies is 0.96, and the analysis in the fractional case leads to exactly the same five mildly extreme distributions isolated in the multiplicative case. At the discipline and the field levels (individual information available on request), only the Multidisciplinary category with  $L$  equal to 0.55 under both strategies deserves to be mentioned as a potential extreme distribution. The conclusion is that for truly different behavior we must turn to what we call the structure of excellence at the upper tail of citation distributions.

Turning towards the high-impact phenomenon, we begin by noting that the distributions of  $H$  values at the sub-field level for the two strategies are highly correlated (correlation coefficient equal to 0.96), and present similar general characteristics. In the multiplicative case, for example, the standard deviation and the coefficient of variation take very large values, 2.4 and 2.2, respectively, and the mean, 1.1, is very much greater than the median, 0.57. All of which indicates that the distribution of  $H$  values is highly skewed to the right and it is likely to present some important extreme cases. Panel A in Table 3 includes 17 sub-fields with the highest  $H$  values in the multiplicative case, as well as five sub-fields with high  $H$  values in the fractional case that are not included in the previous set.

**Table 3 around here**

The following three points should be emphasized.

1. If we consider sub-fields with  $H$  values greater than 3.5 according to either strategy as extreme, there are eight of them, the first seven of which are common to both strategies. A weaker criterion, according to which a sub-field with  $H$  greater than or equal to 1.8 in either strategy should be considered as a mildly extreme distribution, would add 14 more sub-fields, of which nine have an  $H$  value above 1.8 in both strategies. In brief, the set of extreme distributions according to both strategies is very similar indeed.

2. There are twelve sub-fields with a  $H$  value according to the fractional strategy greater than or equal to the value according to the multiplicative strategy. In the remaining ten cases the opposite is the case. Therefore, there is no systematic tendency for  $H$  values to be greater according to one of the two strategies. Surely the most notable case is Statistics & Probability where the  $H$  value in the multiplicative case is almost 100% greater than in the fractional case. Both the MCR and the coefficient of variation within high-impact articles are also much larger in the multiplicative case for this sub-field.

3. Within the set of extreme distributions, the following comments are in order. Firstly, two sub-fields –Crystallography, and Medicine, Research & Experimental– were already characterized as “residual sub-fields” in Albarrán *et al.* (2011a). Secondly, six out of eight sub-fields in Computer Science are considered extreme. The conclusion is inescapable: this field’s structure of excellence is entirely different from the rest. Thirdly, two important sub-fields within Physics are classified as extreme: Physics, Particle & Fields, and Physics, Multidisciplinary. Fourthly, perhaps not surprisingly the Multidisciplinary category behaves as a mildly extreme distribution at the sub-field level. Fifthly, only two Social Sciences can be considered as mildly extreme sub-fields: International Relations, and Ethnic Studies.

At higher aggregate levels, together with the original distributions, we should take into account the normalized distributions according to both strategies. Individual information in the multiplicative

and the fractional case is available in Table C in Appendix II, while Panel B in Table 3 lists the disciplines and fields with the highest  $H$  values in both scenarios.

1. As expected, extreme  $H$  values decrease with normalization. The ranking of the first two disciplines remains unchanged after normalization, but as soon as differences in sub-field MCRs are taken into account, Applied Mathematics and Particle & Nuclear Physics, which appear as third and fifth disciplines among the original distributions, now occupy rank four and seven among normalized distributions. A similar phenomenon takes place among fields: due to the extreme behavior displayed by the Statistics & Probability sub-field, Mathematics appears as the first extreme distribution among un-normalized fields. However, as soon as the low MCRs of other mathematical sub-fields is taken into account in the normalization process, Mathematics goes down to occupy rank three among normalized field distributions.

2. Interestingly enough, there is now complete agreement between the multiplicative and the fractional strategies about extreme sets. The main difference is the ranking of Applied Mathematics and Mathematics at the discipline and the field levels, which is always higher in the multiplicative case. The reason, of course, is the large difference already noted about Statistics and Probability at the sub-field level.

3. Not surprisingly, disciplines consisting of single extreme sub-fields remain extreme at the discipline level. This is the case of Crystallography; Medicine, Research & Experimental, and the Multidisciplinary category. The first two cause the field Residual Sub-fields to become an extreme field. Not surprisingly either in view of results at the sub-field level, Computer Science & Information Technology among disciplines, and Computer Science among fields are clear extreme distributions at their aggregate level.

## **IV. DIFFERENCES BETWEEN THE MULTIPLICATIVE AND THE FRACTIONAL STRATEGIES**

### **IV. 1. The Number of Articles According to the Two Strategies**

By construction, differences between the multiplicative and the fractional strategies start with the number of articles. The individual information in this respect is in the first part of Table D in Appendix II. At each aggregation level, the last three rows report the mean number of articles the standard deviation, and the coefficient of variation. The second part of this Table contains the distribution of the total number of articles by categories at each aggregation level. The difference between the distributions has a positive (negative) sign when the difference between the numbers of articles according to the two strategies is above (below) the mean. The following three points should be emphasized.

1. In our dataset there is no information about the distribution of sub-fields, disciplines or fields by size, measured by the number of people working in them, but the numbers must be very different indeed. Moreover, publication practices vary very much across categories at every aggregate level. In some cases authors publishing one article per year would be among the most productive, while in other instances authors –either alone or as members of a research team– are expected to publish several papers per year. Consequently, distribution sizes measured by the number of articles in Table D are expected to differ at all aggregation levels. In particular, judging by the large dispersion measures sub-field sizes according to both strategies are very different indeed. In the multiplicative case, for example, the range of variation goes from a minimum of 403 and 418 articles (Engineering, Marine; and Biology, Miscellaneous), and thirteen more sub-fields with fewer than 3,000 articles, to eight sub-fields with more than 100,000 articles and a maximum of 213,036 articles in Biochemistry and Molecular Biology. Discipline sizes are also very different. The range of variation goes from two out of 80 disciplines with fewer than 12,000 articles, to six with more than 100,000 articles. There are four large fields with more than 450,000 articles, three around 350,000, three with fewer than 100,000, and the remaining 10 with intermediate sizes.

2. Interestingly enough, the correlation coefficient between sub-field sizes according to the multiplicative and the fractional strategies is 0.98. However, as has already been observed in Table 1, the two procedures lead to very large size differences. The question the potential user needs to

know is whether or not the differences are uniform across categories at each aggregate level. Focusing on the important sub-field case, the median of the distribution of the differences between the numbers of articles is about 64%, or seven points above the mean. Correspondingly, there are 58 out of 219 sub-fields in which the number of articles in the multiplicative case is at least 100% greater than in the fractional case, while there are only 17 sub-fields in which this difference is below 20%. The relative importance of each of the former 58 sub-fields in the multiplicative case is at least 27% greater than in the fractional case, while the relative importance of each of the latter 17 sub-fields in the multiplicative case is at least 24% smaller than in the fractional case.<sup>5</sup>

On the other hand, differences between the two strategies tend to diminish as we proceed towards higher aggregate levels. Thus, there are three out of 80 disciplines (and two out of 20 fields) in which the number of articles in the multiplicative case is at least 100% (or 60%) greater than in the fractional case, while only in the Multidisciplinary sub-field –that appears as a single discipline and a single field– this difference is below 10%.<sup>6</sup>

3. A final interesting question is whether size differences increase with size. A correlation coefficient of -0.19 between these two variables in the sub-field case indicates that this is not the case.

#### **IV.2. Other Characteristics: MCR, $L$ , and $H$**

The final question that needs to be investigated is the differences between the two strategies in other dimensions different from size. In particular, we study differences in MCR, and the  $L$  and  $H$  indicators that are size- and scale-invariant. The individual information about the MCRs according to both strategies at the sub-field level is in Table E in Appendix II. It deserves the following three comments.

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<sup>5</sup> For later reference, we record here the six sub-fields for which the number of articles in the multiplicative case is at least 170% greater than in the fractional case: (i) Medical Ethics; (ii) Medical Informatics; (iii) Mathematical & Computational Biology; (iv) Neuroimaging; (v) Nanoscience & Nanotechnology; (vi) Ergonomics, as well as the six sub-fields for which this difference is smaller than 10%: (i) Physics, Multidisciplinary; (ii) Multidisciplinary Sciences; (iii) Medicine, General, & Internal; (iv) Andrology; (v) Rheumatology; (vi) Ornithology.

<sup>6</sup> The exceptional three disciplines are Classical Physics; Instruments and Instrumentation, and Other Clinical Medicine, while the two fields are Materials Science, and the so-called Residual Sub-fields –a field consisting of four sub-fields that created difficulties for the appearance of a power law in their natural categories (for more details, see Albarrán *et al.*, 2011a).

1. In a majority of cases –136 sub-fields– the MCR is greater according to the multiplicative strategy. However, the opposite is the case in a non-negligible number of cases: 82 sub-fields. Only in Neuroimaging do the MCRs according to both strategies coincide.

2. In spite of very large differences in the number of articles according to both strategies, differences in MCRs are not that large: they amount to less than 5% in 114 sub-fields, and between 5% and 10% in another 59 cases. There are only 36 sub-fields with differences amounting between 10% and 20%, and 10 with differences above 20%.<sup>7</sup> In other words, MCRs in journals with single or multiple assignments to sub-fields are not that different. On the other hand, the correlation coefficient between MCRs according to both strategies is very high: 0.98.

3. The correlation coefficient between differences in MCRs in absolute terms and differences in size is -0.01, an indication that to have a large number of articles in journals with multiple assignments is not a sufficient condition for large MCR differences between the multiplicative and the fractional strategies.

Turning now to the low-impact phenomenon, it is observed that the  $L$  values according to the two strategies at the sub-field level are very close to each other (see Table B in Appendix II): in only five sub-fields does the difference in favor of the multiplicative strategy amount to more than 5%, while this is the case in favor of the fractional strategy in 17 cases. Only for Women’s Studies and Transportation does the  $L$  value for the fractional strategy exceeds that of the multiplicative strategy by more than 10%. Aggregation and normalization further reduces differences between the two alternatives: only in three out of 80 normalized disciplines, as well as in Computer Science among 20 fields, is this difference is greater than 5% (individual data is available on request). On the other hand, as we saw in Section III.4 the correlation coefficient of  $L$  values according to the two

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<sup>7</sup> The ten sub-fields for which the MCR according to the multiplicative strategy is at least 20% greater than according the fractional strategy are: (i) Agriculture, Multidisciplinary; (ii) Horticulture; (iii) Statistics & Probability; (iv) Imaging Science & Photographic Technology; (v) Mining & Mineral Processing; (vi) Psychology, Psychoanalysis; (vii) Transportation; (viii) Women’s Studies; (ix) Metallurgy & Metallurgical Engineering; (x) Information Science & Library Science. The nine sub-fields for which the opposite is the case by at least 10% are: (i) Materials Science, Composites; (ii) Pathology; (iii) Physics, Condensed Matter; (iv) Physics, Applied; (v) Physics, Particles & Fields; (vi) Physics, Nuclear; (vii) Meteorology & Atmospheric Sciences; (viii) Immunology; (ix) Chemistry, Medicinal.

strategies at both the sub-field and the discipline level is 0.96. All of which indicates that, as far as low-impact is concerned, choosing either of the two strategies has truly minor consequences.

As we have seen, differences in MCRs are not that large, while differences in low-impact values are negligible. However, differences in  $H$  values are rather significant. As can be seen in Table 4 (that summarizes the individual information in Tables B and C in Appendix II), in 120 out of 219 sub-fields, 17 out of 80 disciplines, and four out of 20 fields, differences in  $H$  values between the two strategies are greater than 10%. Moreover, in 30 sub-fields and one discipline these differences exceed 30%. Thus, when we measure citation impact excellence with the  $H$  indicator with a CCL fixed at the 80<sup>th</sup> percentile of world distributions, the quantitative picture drawn through the multiplicative and the fractional strategies is quite different indeed. Nevertheless, it should be emphasized that the two strategies coincide in other respects. On the one hand, the correlation coefficient of this indicator for the two strategies is 0.85 and 0.99 at the sub-field and discipline levels. On the other, as we saw in Section III.4 the set of high-impact extreme distributions for the two strategies is very similar indeed.

**Table 4 around here**

## V. CONCLUSIONS

The assignment of a number of journals to multiple sub-fields poses serious practical problems in many datasets. In this paper we have compared two alternative strategies to cope with this situation: a multiplicative strategy, according to which articles should be wholly counted as many times as necessary when the journal in which they have been published is assigned to several sub-fields, and a fractional strategy in which articles should be weighted by the inverse of the number of sub-fields to which the publishing journal is assigned. We have introduced a novel normalization procedure that in the construction of aggregate categories in the multiplicative case takes into account differences in citation practices across sub-fields at the lowest aggregation level.

At every aggregate level, the fractional strategy preserves the number of articles in the original dataset. However, in the multiplicative strategy the number of articles in each extended count is always greater than in the original dataset, and decreases as we move up in the aggregation scheme. The key to the normalization procedure in this approach is the reconciliation of every aggregate level with the sub-field level. This is done as follows. Given the number of sub-fields to which an article is assigned, consider the subset of them that belongs to a given aggregate category, for example the subset of sub-fields that belong to a given discipline. Then the multiplicative strategy reconciles the discipline with the sub-field level by weighting this article by the number of sub-fields in that subset. This opens the way for the normalization procedure to proceed as in the fractional case.

Quite independently from the fact that we prefer the first solution on *a priori* grounds, the main empirical conclusions can be summarized in the following three points.

1. By construction, the number of articles according to the multiplicative strategy is always greater than the number of articles in the fractional strategy. At a maximum –at the lowest aggregation level– on average this difference is 57%. More importantly, differences between the two strategies are far from uniform across categories at different aggregation levels. For example, there are 58 out of 219 sub-fields in which the number of articles in the multiplicative case is at least 100% greater than in the fractional case, while in 17 sub-fields this difference is below 20%.

2. The two strategies differ in the way they treat articles coming from journals assigned to multiple sub-fields. It turns out that –in certain respects– the citation characteristics of these articles do not differ much from those of articles coming from journals assigned to a single sub-field. Thus, in spite of the wide differences in the mix between the two types of articles –which give rise to the differences in the number of articles just reviewed–, the two strategies lead to un-normalized and normalized citation distributions that have many important features in common. Firstly, MCRs for individual sub-fields according to the two strategies are not very different from each other. Specifically, MCR differences amount to less than 5% in 114 out of 219 sub-fields, and between 5% and 10% in another 59 cases. Furthermore, the MCR distributions according to the two strategies



are highly correlated. Secondly, normalized and un-normalized citation distributions according to either the multiplicative or the fractional strategies share the same skewed shape. The proportion of articles that receive (1) none or few citations, (2) are fairly cited, and (3) are remarkably or outstandingly cited is, approximately, 69/21/10. These three classes of articles account for the proportions 34/21/45 of all citations. Thirdly, the measures of low-impact according to both strategies are very close to each other: for example, differences between the two strategies amount to less than 5% in 197 out of 219 sub-fields. Furthermore, the two distributions are very highly correlated in this respect at all aggregate levels.

3. There is no question that the more important part of citation distributions is the upper tail. By fixing the CCL at the 80<sup>th</sup> percentile, this paper focuses the attention on the 20% of most highly cited articles. The main conclusion is that excellence is not equally structured in all citation distributions. It turns out that this structure is differently captured by our high-impact indicator under the two strategies in contention: in 63 out of 219 sub-fields, 16 out of 80 disciplines, and two out of 20 fields, differences in  $H$  values between the two strategies are greater than 20%. On the other hand, there is a set of extreme citation distributions that behave very differently from the rest in the sense that they are characterized by a very high  $H$  value. An important finding in this paper is that this set essentially coincides under the multiplicative and the fractional strategies. In particular, at the lowest aggregation level there are about eight sub-fields with  $H$  values that are well above the mean over the entire sub-field set according to both strategies.

In brief, although the similarity of citation characteristics of articles published in journals assigned to one or several sub-fields guarantees that choosing one of the two strategies may not lead to a radically different picture in practical applications, the list of categories with high-impact values at any aggregate level may considerably differ depending on that choice.

Four possible extensions might be mentioned. Firstly, it is worthwhile to explore whether the main conclusions of the paper are robust to the CCL choice. Secondly, as indicated in Section III.2 Albarrán *et al.* (2001a) investigated the existence of a power law representing the very top of the

upper tail of un-normalized citation distributions in the multiplicative case. It would be certainly interesting to extend this work to the fractional case, as well as to normalized distributions under both strategies. Thirdly, it should be noted that our high-impact indicator is not robust to the presence of a handful of articles with a truly phenomenal number of citations. Therefore, it would also be interesting to explore the issue of extreme distributions using indicators of citation excellence robust to extreme observations. Fourthly, an important research question is to explain why excellence is not equally structured in all citation distributions, and why in some of them it behaves so differently from the rest.

We should not end this paper without pointing out how convenient it would be to have a classification system available in which each article could be assigned to a single sub-field. Thomson Scientific does that for the dataset used in this paper, but only for a notion of “sub-field” that leads to a set of only 22 broad categories (This is the classification system used in Albarrán and Ruiz-Castillo, 2011, and Albarrán *et al.*, 2011b, c). In this context, we should welcome the recent work by Archambault *et al.* (2011) in which individual journals are assigned to single, mutually exclusive categories using a hybrid approach that combines algorithmic methods and expert judgment. Nevertheless, in our view it would be important to verify whether citation distributions at every aggregation level in the new classification system satisfy the broad features that in both Albarrán *et al.* (2011a) and this paper have been seen to characterize distributions under the multiplicative and the fractional strategies.

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**Table 1. Number of Articles in the Extended Counts According to the Multiplicative Strategy at Different Aggregation Levels**

	<b>Number of Articles</b>	<b>Index</b>
<b>Original Dataset and Fractional Strategy</b>	3,648,524	100.0
<b>EXTENDED COUNTS:</b>		
Sub-field	5,735,512	157.1
Discipline	5,371,569	147.2
Field	4,876,818	133.7

**Table 2. Characteristic Scores and Scales. Means (and Standard Deviations)**

	Percentage Of Articles In Categories:		Percentage of Citations In Categories:	
	1 + 2	4 + 5	2	4 + 5
<b>A. UN-NORMALIZED SUB-FIELDS</b>				
<b>Multiplicative Strategy*</b>	68.6 (3.7)	10.0 (1.7)	21.1 (5.0)	44.9 (4.6)
<b>Fractional Strategy</b>	68.3 (3.4)	10.2 (1.6)	21.5 (4.2)	44.7 (3.9)
<b>B. NORMALIZED DISCIPLINES:</b>				
<b>Multiplicative Strategy</b>	68.4 (2.6)	10.0 (1.3)	22.3 (3.2)	43.9 (2.9)
<b>Fractional Strategy</b>	68.4 (2.8)	10.0 (1.3)	21.8 (3.3)	44.5 (3.0)
<b>C. NORMALIZED FIELDS</b>				
<b>Multiplicative Strategy</b>	68.7 (1.8)	9.7 (1.0)	21.6 (3.4)	44.6 (3.3)
<b>Fractional Strategy</b>	68.7 (2.0)	9.7 (1.1)	21.1 (3.5)	45.1 (3.3)

\* The information in this row is taken from Table 6 in the Working Paper version of Albarrán *et al.* (20011a)

**Table 3.A. Extreme Un-normalized Sub-field Distributions According to the Multiplicative and the Fractional Approach**

<b>High-impact Values:</b>	<b>Multiplicative (1)</b>	<b>Fractional (2)</b>	<b>(3) = (1) – (2) In %</b>
1. Medicine, General & Internal	20.7	22.3	-7.2
2. Crystallography	17.7	17.2	2.7
3. Mathematical & Computational Biology	15.5	11.8	32.0
4. Statistics & Probability	14.8	7.6	93.1
5. Computer Science, Interdisciplinary Applications	12.9	9.9	29.5
6. Biochemical Research Methods	5.2	3.7	40.8
7. Physics, Particles & Fields	3.7	4.0	-6.6
8. Medicine, Research & Experimental	3.0	3.5	-15.2
9. Engineering, Petroleum	1.1	4.7	-76.7
10. Physics, Multidisciplinary	3.1	3.3	-7.7
11. Computer Science, Information Systems	3.3	2.8	20.1
12. Computer Science, Hardware & Architecture	2.8	2.3	25.6
13. Computer Science, Theory & Methods	2.8	1.9	42.2
14. Multidisciplinary Sciences	2.1	2.2	-0.7
15. Computer Science, Artificial Intelligence	2.1	1.8	15.8
16. Biotechnology & Applied Microbiology	2.1	2.1	-2.7
17. Telecommunications	2.0	1.7	13.0
18. International Relations	1.9	2.3	-16.1
19. Materials Science, Characterization & Testing	1.8	1.8	-3.6
20. Psychology, Multidisciplinary	1.4	2.0	-31.1
21. Mining & Mineral Processing	1.3	2.0	-36.2
22. Ethnic Studies	1.1	2.3	-51.2
<b>Mean Sub-field Value</b>	1.1	1.1	
<b>Standard Deviation</b>	2.4	2.2	

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**Table 3.B. Extreme Discipline and Field Distributions In the Un-normalized and the Normalized Case**

Un-normalized Discipline Distributions:				Normalized Discipline Distributions:			
	Multiplicative (1)	Fractional (2)	(3) = (1) – (2) In %		Multiplicative (1)	Fractional (2)	(3) = (1) – (2) In %
1. Crystallography	17.7	17.2	2.7	1. Crystallography	17.7	17.2	2.7
2. General & Int. Med.	8.4	8.3	1.0	2. General & Int. Med.	4.6	5.1	-9.0
3. Applied Mathematics	5.9	2.5	136.3	3. Comp. Sc. & Inf. Tech.	3.6	2.8	29.5
4. Comp. Sc. & Inf. Tech.	5.4	5.5	-2.4	4. Applied Mathematics	3.5	2.5	36.3
5. Part. & Nuclear Physics	3.2	3.5	-8.1	5. Medicine, Res. & Exp.	3.0	3.5	-15.2
6. Medicine, Res. & Exp.	3.0	3.5	-15.2	6. Multidisciplinary Physics	2.2	2.4	-7.2
7. Mult. Physics	2.9	2.8	4.2	7. Part. & Nuclear Physics	2.2	2.7	-20.2
8. Multidisciplinary	2.1	2.2	-0.7	8. Multidisciplinary	2.1	2.2	-0.7
<b>Mean Values</b>	1.3	1.2		<b>Mean Values</b>	1.1	1.1	
<b>Standard Deviation</b>	2.2	2.1		<b>Standard Deviation</b>	2.0	2.0	

  

Un-normalized Field Distributions:				Normalized Field Distributions:			
	Multiplicative (1)	Fractional (2)	(3) = (1) – (2) In %		Multiplicative (1)	Fractional (2)	(3) = (1) – (2) In %
MATHEMATICS	6.3	2.2	180.8	COMPUTER SCIENC	3.6	2.8	29.5
COMPUTER SCIENCE	5.4	5.5	-2.4	RESID. SUB-FIELDS	3.0	3.7	-17.3
RESID. SUB-FIELDS	4.1	4.8	-15.1	MATHEMATICS	2.4	1.6	53.3
MULTIDISCIPLINARY	2.1	2.2	-0.7	MULTIDISCIPLINAR	2.1	2.2	-0.7
<b>Mean Values</b>	1.6	1.5		<b>Mean Values</b>	1.2	1.2	
<b>Standard Deviation</b>	1.7	1.4		<b>Standard Deviation</b>	0.9	0.8	

**Table 4. Differences In High-impact values Between the Multiplicative and the Fractional Strategies at Different Aggregation Levels**

**A. SUB-FIELDS**

	<b>0-10%</b>	<b>10-20%</b>	<b>20-30%</b>	<b>30-50%</b>	<b>&gt; 50%</b>
<b>Multiplicative &gt; Fractional</b>	40	30	17	12	3
<b>Multiplicative &lt; Fractional</b>	59	26	16	12	3
<b>Total</b>	99	56	33	24	6

**B. DISCIPLINES**

	<b>0-10%</b>	<b>10-20%</b>	<b>20-30%</b>	<b>&gt; 30%</b>
<b>Multiplicative &gt; Fractional</b>	16	9	7	1
<b>Multiplicative &lt; Fractional</b>	29	10	4	4
<b>Total</b>	45	19	11	5

**C. FIELDS**

	<b>0-10%</b>	<b>10-20%</b>	<b>&gt; 20%</b>
<b>Multiplicative &gt; Fractional</b>	3	2	2
<b>Multiplicative &lt; Fractional</b>	8	5	-
<b>Total</b>	11	7	2



## Appendix I. A numerical example

Assume that there are  $N = 16$  articles, five sub-fields, indexed by  $s = 1, \dots, 5$ , and two disciplines,  $d_1$  and  $d_2$ , consisting of the first two and the last three sub-fields, respectively. All articles are assigned to a single sub-field, except an article that receives 8 citations and is assigned to the five sub-fields.

**Fractional strategy.** For the article with 8 citations,  $X_i$  contains the five sub-fields, so that  $x_i = 5$ . Sub-field distributions can be expressed as  $c_i = \{w_{si} c_{si}\}$  where  $w_{si} = 1/x_i$  for all  $s \in X_i$  and  $c_{si}$  is the number of citations received by article  $i$  in sub-field  $s$  in the multiplicative strategy. Of course,  $\sum_{s \in X_i} w_{si} = 1$ . Therefore, the five sub-fields and their corresponding means in the fractional strategy are:

$$\begin{aligned} c_1 &= (1, 2, 8/5, 10), & m_1 &= 4.5625 \\ c_2 &= (1, 1, 8/5, 2), & m_2 &= 1.75 \\ c_3 &= (1, 4, 8/5, 6), & m_3 &= 3.9375 \\ c_4 &= (1, 3, 8/5, 5), & m_4 &= 3.3125 \\ c_5 &= (4, 4, 8/5, 4), & m_5 &= 4.25. \end{aligned}$$

Note that  $\sum_i w_{si} = 16/5$  is the (fractional) number of articles in sub-field  $s = 1, \dots, 5$ , so that  $\sum_i \sum_s w_{si} = N = 16$ . In this strategy, the two disciplines are the union of the corresponding sub-fields:

$$\begin{aligned} c_{d1} &= (1, 2, 8/5, 10) \cup (1, 1, 8/5, 2), \\ c_{d2} &= (1, 4, 8/5, 6) \cup (1, 3, 8/5, 5) \cup (4, 4, 8/5, 4) \end{aligned}$$

The (fractional) number of articles in the two disciplines are  $\sum_{s \in d1} \sum_i w_{si} = 2 (16/5) = 32/5$ , and  $\sum_{s \in d2} \sum_i w_{si} = 3 (16/5) = 48/5$ , so that the total number of articles at the discipline level is  $80/5 = 16 = N$ . In this case, the discipline MCRs are equal to the sum of the corresponding sub-field MCRs

$$\begin{aligned} m_{d1} &= 3.15625 = (1/2) 4.5625 + (1/2) 1.75 \\ m_{d2} &= 3.8333 = (1/3) (3.9375 + 3.3125 + 3.3125). \end{aligned}$$

Finally, the normalized sub-field and discipline distributions are:

$$z_1^f = (1/m_1, 2/m_1, 8/5m_1, 10/m_1) \quad z_2^f = (1/m_2, 1/m_2, 8/5m_2, 2/m_2) \quad z_3^f = (1/m_3, 4/m_3, 8/5m_3, 6/m_3)$$

and

$$z_4^f = (1/m_4, 3/m_4, 8/5m_4, 5/m_4) \quad z_5^f = (4/m_5, 4/m_5, 8/5m_5, 4/m_5)$$

$$z_{d1}^f = z_1^f \cup z_2^f, \quad z_{d2}^f = z_3^f \cup z_4^f \cup z_5^f.$$

Of course, the MCR in all these distributions is equal to one.

**Multiplicative strategy.** The five sub-fields and their corresponding means are:

$$\begin{aligned} c_1 &= (1, 2, 8, 10), & M_1 &= 5.25 \\ c_2 &= (1, 1, 8, 2), & M_2 &= 3 \\ c_3 &= (1, 4, 8, 6), & M_3 &= 4.75 \\ c_4 &= (1, 3, 8, 5), & M_4 &= 4.25 \\ c_5 &= (4, 4, 8, 4), & M_5 &= 5. \end{aligned}$$

Thus,  $N_s = 4$  for all  $s$ , so that in the sub-field extended count  $N_{SF} = \sum_s N_s = 20$ .

For the article with 8 citations,  $Y_l$  contains the two disciplines, so that  $y_l = 2$ . In this strategy, the two disciplines and their corresponding means are:

$$c_{d1} = (1, 1, 1, 2, 2, 8, 10) \quad M_{d1} = 3.5714$$

$$c_{d2} = (1, 1, 3, 4, 4, 4, 8, 5, 6), \quad M_{d2} = 4.$$

Note that  $N_{d1} = 7$ , and  $N_{d2} = 10$ , so that  $N_D = \sum_d N_d = 17$ , with  $N_{SF} > N_D > N$ . Discipline MCRs are not equal to the weighted sum of the original sub-fields MCRs, that is:

$$M_{d1} \neq \sum_{s \in d1} (N_s / \sum_s N_s) M_s = (1/2) 5.25 + (1/2) 5.25 = 4.125;$$

$$M_{d2} \neq \sum_{s \in d2} (N_s / \sum_s N_s) M_s = (1/3) 4.75 + (1/3) 4.25 + (1/3) 5 = 4.666.$$

The two disciplines partition the set  $X_l$  of sub-fields as follows:  $X_l = X_{l1} \cup X_{l2}$ , with  $x_{l1} = 2$ , and  $x_{l2} = 3$ , so that  $x_{l1} + x_{l2} = 2 + 3 = 5 = x_l$ . The new sub-field distributions,  $c'_i = \{v_{si} c_{si}\}$  where  $v_{si} = 1/x_{li}$  and  $c_{si} = c_l$  for all  $s \in X_{li}$ , and their corresponding means are:

$$c'_1 = (1, 2, 8/2, 10), \quad M'_1 = 4.8571$$

$$c'_2 = (1, 1, 8/2, 2), \quad M'_2 = 2.2857$$

$$c'_3 = (1, 4, 8/3, 6), \quad M'_3 = 4.1$$

$$c'_4 = (1, 3, 8/3, 5), \quad M'_4 = 3.5$$

$$c'_5 = (4, 4, 8/3, 4), \quad M'_5 = 4.4.$$

Note that  $\sum_i v_{si} = 3.5$  is the (fractional) number of articles for  $s = 1, 2$ , and  $\sum_i v_{si} = 3.33$  for  $s = 3, 4, 5$ , so that  $\sum_s \sum_i v_{si} = 17 = N_D$ . The discipline MCRs are seen to be equal to the weighted means of the corresponding new sub-field MCRs:

$$M_{d1} = 3.5714 = \sum_{s \in d1} (N'_s / N_{d1}) M'_s = (1/2) 4.8571 + (1/2) 2.2857$$

$$M_{d2} = 4 = \sum_{s \in d2} (N'_s / N_{d2}) M'_s = (1/3) 4.1 + (1/3) 3.5 + (1/3) 4.4 = 4.$$

Finally, the normalized new sub-field distributions are constructed as in the fractional case:

$$\tilde{c}'_1 = (1/M'_1, 2/M'_1, 8/2M'_1, 10/M'_1) \quad \tilde{c}'_2 = (1/M'_2, 1/M'_2, 8/2M'_2, 2/M'_2)$$

$$\tilde{c}'_3 = (1/M'_3, 4/M'_3, 8/3M'_3, 6/M'_3) \quad \tilde{c}'_4 = (1/M'_4, 3/M'_4, 8/3M'_4, 5/M'_4) \quad \tilde{c}'_5 = (4/M'_5, 4/M'_5, 8/3M'_5, 4/M'_5).$$

The normalized discipline distributions are:

$$\tilde{c}_{d1} = (1/M'_1, 2/M'_1, (8/2)[(1/M'_1) + (1/M'_2)], 10/M'_1, 1/M'_2, 1/M'_2, 2/M'_2),$$

$$\tilde{c}_{d2} = (1/M'_3, 4/M'_3, (8/3)[(1/M'_3) + (1/M'_4) + (1/M'_5)], 6/M'_3, 1/M'_4, 3/M'_4, 5/M'_4, 4/M'_5, 4/M'_5, 4/M'_5).$$

Of course, the MCR in all the normalized distributions is equal to one.

## APPENDIX II

**Table A.I. Characteristic Scales and Scores for the Original, Un-normalized Distributions at the Sub-field Level According to the Fractional Strategy**

	Percentage of Observations By Category:						
	1	2	1+2	3	4	5	4+5
<b><i>I. BIOSCIENCES</i></b>							
1. BIOLOGY	21.4	48.6	70.0	20.0	6.7	3.2	10.0
2. BIOLOGY, MISCELLANEOUS	28.3	42.7	71.0	18.9	6.3	3.8	10.1
3. EVOLUTIONARY BIOLOGY	5.7	60.4	66.0	23.6	7.4	3.0	10.4
4. BIOCHEMICAL RESEARCH METHODS	7.8	62.2	70.0	21.8	6.2	2.0	8.1
5. BIOCHEMISTRY & MOLECULAR BIOLOGY	5.9	62.6	68.5	22.2	6.6	2.7	9.3
6. BIOPHYSICS	9.0	57.1	66.0	23.1	7.3	3.5	10.9
7. CELL BIOLOGY	5.7	65.3	71.0	20.0	6.1	2.8	9.0
8. GENETICS & HEREDITY	8.1	63.6	71.7	20.0	5.7	2.5	8.2
9. DEVELOPMENTAL BIOLOGY	3.5	63.7	67.1	22.0	7.4	3.5	10.9
<b><i>II. BIOMEDICAL RESEARCH</i></b>							
10. PATHOLOGY	11.5	56.2	67.7	21.9	7.0	3.4	10.4
11. ANATOMY & MORPHOLOGY	15.9	51.5	67.4	22.7	6.8	3.1	9.9
12. ENGINEERING, BIOMEDICAL	13.4	52.5	65.9	22.1	8.1	4.0	12.1
13. BIOTECH. & APPLIED MICROBIOLOGY	13.7	55.8	69.5	22.3	6.0	2.2	8.2
14. MEDICAL LABORATORY TECHNOLOGY	16.8	52.6	69.5	21.4	6.2	2.9	9.1
15. MICROSCOPY	14.1	54.8	68.9	21.5	6.5	3.1	9.6
16. PHARMACOLOGY & PHARMACY	10.6	57.6	68.2	21.7	6.7	3.4	10.1
17. TOXICOLOGY	11.3	57.4	68.8	21.7	6.6	2.9	9.6
18. PHYSIOLOGY	7.1	55.9	63.0	24.0	8.5	4.5	13.0
<b><i>III. CLINICAL MEDICINE I (INTERNAL)</i></b>							
19. CARDIAC & CARDIOVASCULAR SYSTEMS	15.9	54.2	70.1	21.0	6.1	2.8	8.8
20. RESPIRATORY SYSTEM	10.8	54.2	65.0	23.1	8.2	3.7	11.9
21. ENDOCRINOLOGY & METABOLISM	5.8	60.8	66.6	22.9	7.4	3.0	10.5
22. ANESTHESIOLOGY	14.6	51.1	65.8	23.2	7.4	3.6	11.0
23. CRITICAL CARE MEDICINE	9.8	58.3	68.1	21.8	6.7	3.3	10.1
24. EMERGENCY MEDICINE	19.7	47.4	67.1	22.2	7.1	3.6	10.7
25. GASTROENTEROLOGY & HEPATOLOGY	11.6	57.6	69.2	21.5	6.4	2.9	9.3
26. MEDICINE, GENERAL & INTERNAL	29.4	53.1	82.5	13.0	3.3	1.2	4.5
27. TROPICAL MEDICINE	17.7	50.4	68.1	20.3	7.7	3.9	11.6
28. HEMATOLOGY	8.3	61.0	69.3	20.8	6.7	3.1	9.8
29. ONCOLOGY	7.2	61.1	68.4	21.9	6.9	2.8	9.7
30. ALLERGY	17.8	49.1	66.9	22.4	7.4	3.3	10.7
31. IMMUNOLOGY	6.2	62.9	69.2	21.7	6.3	2.8	9.1
32. INFECTIOUS DISEASES	10.2	56.3	66.6	22.7	7.3	3.5	10.8
<b><i>IV. CLIN. MED. II (NON-INTERNAL)</i></b>							
33. GERIATRICS & GERONTOLOGY	16.2	50.3	66.5	22.6	7.3	3.6	10.9
34. OBSTETRICS & GYNECOLOGY	16.4	51.0	67.4	22.1	7.0	3.4	10.5
35. ANDROLOGY	12.1	54.4	66.4	22.4	7.3	3.9	11.2
36. REPRODUCTIVE BIOLOGY	6.9	59.0	66.0	22.9	7.4	3.8	11.2
37. GERONTOLOGY	16.6	49.9	66.4	21.9	7.5	4.1	11.6
38. DENTISTRY, ORAL SURGERY	14.7	53.4	68.2	20.6	7.8	3.4	11.2
39. DERMATOLOGY	16.8	53.4	70.2	20.1	6.6	3.1	9.7

40. UROLOGY & NEPHROLOGY	14.5	55.0	69.5	21.3	6.4	2.8	9.2
41. OTORHINOLARYNGOLOGY	21.4	40.7	62.1	25.7	8.2	4.0	12.2
42. OPHTHALMOLOGY	15.2	51.1	66.3	23.2	7.3	3.2	10.5
43 INTEGRATIVE & COMPLEMENTARY MEDICINE	23.3	38.1	61.4	25.6	9.5	3.5	13.0
44. CLINICAL NEUROLOGY	13.1	56.0	69.1	21.1	6.7	3.2	9.9
45. PSYCHIATRY	14.9	53.5	68.4	21.4	6.8	3.3	10.2
46. RADIOLOGY, NUCLEAR MED. & IMAGING	14.6	53.6	68.1	21.8	6.9	3.2	10.1
47. ORTHOPEDICS	17.8	49.7	67.5	21.4	7.3	3.8	11.1
48. RHEUMATOLOGY	10.7	56.2	66.9	22.6	7.5	3.0	10.4
49. SPORT SCIENCES	20.4	44.5	64.9	22.6	8.5	4.0	12.5
50. SURGERY	17.6	52.2	69.8	20.4	6.8	3.0	9.8
51. TRANSPLANTATION	17.6	50.6	68.2	21.9	6.8	3.1	9.8
52. PERIPHERAL VASCULAR DISEASE	10.0	59.4	69.4	21.3	6.5	2.8	9.2
53. PEDIATRICS	20.2	46.6	66.8	22.8	7.2	3.2	10.4

#### ***V. CL MED. III (HEALTH & OTHER SCS.)***

54. HEALTH CARE SCIENCIES & SERVICES	18.2	49.0	67.2	23.0	6.9	2.9	9.8
55. HEALTH POLICY & SERVICES	16.1	50.2	66.4	23.3	7.2	3.1	10.3
56. MEDICINE, LEGAL	18.0	48.9	66.9	21.6	8.0	3.5	11.5
57. NURSING	25.8	33.5	59.3	29.0	7.8	3.9	11.7
58. PUBLIC, ENVIRON. & OCCUP. HEALTH	13.5	54.5	67.9	21.9	6.8	3.3	10.2
59. REHABILITATION	23.4	40.2	63.5	24.1	8.0	4.4	12.4
60. SUBSTANCE ABUSE	9.0	56.2	65.2	22.8	8.1	3.9	12.0
61. EDUCATION, SCIENTIFIC DISCIPLINES	32.0	34.1	66.1	22.0	7.9	4.0	11.9
62. MEDICAL INFORMATICS	27.5	38.2	65.7	24.4	7.2	2.7	9.9

#### ***VI. NEUROSCIENCE & BEHAVIOR***

63. NEUROIMAGING	17.2	52.7	69.9	20.3	6.5	3.3	9.8
64. NEUROSCIENCES	7.2	62.5	69.7	20.8	6.3	3.2	9.5
65. BEHAVIORAL SCIENCES	4.6	57.6	62.2	24.8	8.8	4.2	13.0
66. PSYCHOLOGY, BIOLOGICAL	7.3	60.7	68.1	22.5	6.6	2.8	9.5
67. PSYCHOLOGY	14.3	51.2	65.5	22.7	7.9	3.9	11.8
68. PSYCHOLOGY, APPLIED	17.0	47.5	64.6	23.4	7.6	4.4	12.0
69. PSYCHOLOGY, CLINICAL	13.2	53.1	66.3	22.6	7.5	3.6	11.1
70. PSYCHOLOGY, DEVELOPMENTAL	11.2	57.0	68.2	21.3	7.0	3.4	10.4
71. PSYCHOLOGY, EDUCATIONAL	23.7	44.0	67.7	21.3	7.7	3.3	11.0
72. PSYCHOLOGY, EXPERIMENTAL	16.4	50.4	66.8	22.1	7.6	3.6	11.1
73. PSYCHOLOGY, MATHEMATICAL	19.1	50.1	69.2	21.6	5.8	3.4	9.2
74. PSYCHOLOGY, MULTIDISCIPLINARY	31.4	44.1	75.4	17.6	4.9	2.1	7.0
75. PSYCHOLOGY, PSYCHOANALYSIS	45.7	28.7	74.4	17.7	5.7	2.2	7.9
76. PSYCHOLOGY, SOCIAL	15.2	53.9	69.1	20.5	6.9	3.5	10.4
77. SOCIAL SCIENCES, BIOMEDICAL	16.7	53.2	69.8	20.7	6.4	3.1	9.5

#### ***VII. CHEMISTRY***

78. CHEMISTRY, MULTIDISCIPLINARY	21.8	49.1	70.9	19.8	6.3	3.0	9.3
79. CHEMISTRY, INORGANIC & NUCLEAR	16.2	48.1	64.3	23.5	8.3	4.0	12.2
80. CHEMISTRY, ANALYTICAL	13.7	53.5	67.2	22.3	7.2	3.3	10.5
81. CHEMISTRY, APPLIED	30.5	36.1	66.6	22.9	7.0	3.5	10.5
82. ENGINEERING, CHEMICAL	28.0	43.1	71.1	19.2	6.7	3.0	9.7
83. CHEMISTRY, MEDICINAL	8.8	56.5	65.3	23.0	8.1	3.7	11.7
84. CHEMISTRY, ORGANIC	10.7	51.9	62.6	25.3	8.4	3.7	12.1
85. CHEMISTRY, PHYSICAL	14.3	51.8	66.1	23.2	7.4	3.4	10.7
86. ELECTROCHEMISTRY	16.9	47.2	64.0	23.2	8.7	4.0	12.8
87. POLYMER SCIENCE	16.7	52.0	68.7	21.7	6.5	3.1	9.6

**VIII. PHYSICS**

88. PHYSICS, MULTIDISCIPLINARY	26.5	48.3	74.8	17.7	5.3	2.1	7.5
89. SPECTROSCOPY	18.3	49.3	67.6	21.6	7.2	3.6	10.8
90. ACOUSTICS	23.0	39.8	62.8	24.4	8.1	4.7	12.8
91. OPTICS	22.8	47.6	70.4	20.1	6.5	3.0	9.5
92. PHYSICS, APPLIED	19.2	51.7	70.9	20.6	5.9	2.5	8.4
93. PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	7.8	58.8	66.6	23.1	6.9	3.4	10.3
94. THERMODYNAMICS (CLASSICAL PHYSICS)	21.8	46.1	67.9	21.4	7.4	3.3	10.7
95. PHYSICS, MATHEMATICAL	18.1	49.0	67.1	22.9	7.0	3.0	10.1
96. PHYSICS, NUCLEAR	24.8	44.3	69.0	21.7	6.4	2.9	9.3
97. PHYSICS, PARTICLES & FIELDS	20.4	53.6	74.0	18.9	5.1	2.0	7.1
98. PHYSICS, CONDENSED MATTER	20.6	49.9	70.6	20.5	6.2	2.7	8.9
99. PHYSICS OF SOLIDS, FLUIDS & PLASMAS	12.4	52.3	64.7	23.2	8.2	4.0	12.1

**IX. SPACE SCIENCES**

100. ASTRONOMY & ASTROPHYSICS	15.1	53.0	68.1	22.4	6.7	2.8	9.5
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**X. MATHEMATICS**

101. MATHEMATICS, APPLIED	34.3	32.7	67.0	21.8	7.9	3.2	11.2
102. STATISTICS & PROBABILITY	31.6	41.6	73.2	20.0	5.1	1.6	6.7
103. MATHEMATICS, INTERDISC. APPL.	23.1	48.6	71.8	19.6	5.7	2.9	8.7
104. SOCIAL SCIENCES, MATH. METHODS	26.7	39.4	66.1	23.6	6.9	3.4	10.3
105. PURE MATHEMATICS	40.9	21.1	62.0	25.6	8.7	3.8	12.5

**XI. COMPUTER SCIENCE**

106. COMP. SC, ARTIFICIAL INTELLIGENCE.	36.9	36.2	73.1	19.5	5.3	2.1	7.4
107. COMPUTER SCIENCE, CYBERNETICS	45.9	27.1	73.0	19.2	5.5	2.4	7.8
108. COMP SC, HARDWARE & ARCHITECTURE	40.8	30.3	71.1	20.1	6.3	2.6	8.9
109. COMP. SC., INFORMATION SYSTEMS	39.7	30.8	70.5	21.4	5.8	2.3	8.1
110. COMP. SC., INTERDIS. APPLICATIONS	30.2	40.0	70.2	21.8	6.0	2.0	7.9
111. COMP. SC., SOFTWARE ENGINEERING	40.2	30.4	70.5	20.6	5.8	3.0	8.9
112. COMP. SC, THEORY & METHODS	48.6	28.2	76.8	17.1	4.3	1.8	6.1
113. MATHEMATICAL & COMPUT. BIOLOGY	13.4	60.4	73.8	20.6	4.5	1.1	5.6

**XII. ENGINEERING**

114. ENG., ELECTRICAL & ELECTRONIC	34.4	37.4	71.7	19.8	5.9	2.5	8.5
115. TELECOMMUNICATIONS	46.1	26.4	72.6	20.2	5.1	2.1	7.2
116. CONSTRUCTION & BUILDING TECH.	32.8	34.6	67.4	20.4	8.3	3.9	12.2
117. ENGINEERING, CIVIL	41.7	30.6	72.3	19.7	5.6	2.4	8.0
118. ENGINEERING, ENVIRONMENTAL	18.0	49.7	67.7	21.8	7.2	3.3	10.5
119. ENGINEERING, MARINE	58.9	19.9	78.8	13.4	4.7	3.1	7.8
120. TRANSPORTATION SC. & TECHNOLOGY	59.5	16.2	75.8	15.6	6.1	2.6	8.6
121. ENGINEERING, INDUSTRIAL	38.0	33.4	71.4	18.2	7.3	3.1	10.4
122. ENGINEERING, MANUFACTURING	33.4	34.8	68.2	19.8	8.5	3.5	12.0
123. ENGINEERING, MECHANICAL	33.6	34.0	67.6	22.2	7.0	3.1	10.2
124. MECHANICS	25.5	40.0	65.5	22.6	7.8	4.2	12.0
125. ROBOTICS	37.6	34.9	72.4	19.4	5.6	2.6	8.2
126. INSTRUMENTS & INSTRUMENTATION	33.0	35.9	68.8	20.4	7.3	3.5	10.8
127. IMAGING SC. & PHOTOGRAPHIC TECH.	30.9	41.9	72.8	18.4	6.3	2.5	8.8
128. ENERGY & FUELS	33.6	36.6	70.1	21.3	6.1	2.5	8.6
129. NUCLEAR SCIENCE & TECHNOLOGY	35.7	31.5	67.3	21.8	7.9	3.1	11.0
130. ENGINEERING, PETROLEUM	68.4	0.0	68.4	22.7	5.3	3.6	8.9
131. AUTOMATION & CONTROL SYSTEMS	38.1	29.1	67.3	21.8	7.8	3.2	10.9
132. ENGINEERING, MULTIDISCIPLINARY	41.1	30.3	71.4	20.3	5.6	2.7	8.2

133. ERGONOMICS	24.5	45.5	70.0	20.2	6.6	3.1	9.8
134. OPERATIONS RES. & MANAG. SCIENCE	30.4	34.0	64.4	24.4	7.8	3.5	11.2

### ***XIII. MATERIALS SCIENCE***

135. MATERIALS SCIENCE, BIOMATERIALS	6.8	57.3	64.1	23.3	8.5	4.1	12.6
136. MATERIALS SCIENCE, CERAMICS	33.6	33.9	67.5	22.2	7.0	3.3	10.3
137. MAT. SC., CHARAC. & TESTING	57.4	16.8	74.2	17.7	5.4	2.7	8.1
138. MAT. SC., COATINGS & FILMS	17.9	48.5	66.4	22.4	7.6	3.5	11.1
139. MATERIALS SCIENCE, COMPOSITES	32.3	32.1	64.4	24.4	7.8	3.4	11.2
140. MATERIALS SCIENCE, PAPER & WOOD	44.2	19.5	63.8	24.0	8.0	4.3	12.2
141. MATERIALS SCIENCE, TEXTILES	40.9	23.0	63.9	25.2	7.0	3.9	10.9
142. METALLURGY & METALL. ENGIN.	41.3	27.7	68.9	21.3	6.7	3.0	9.7
143. NANOSCIENCE & NANOTECHNOLOGY	20.2	50.2	70.4	21.3	6.0	2.3	8.3

### ***XIV. GEOSCIENCES***

144. GEOCHEMISTRY & GEOPHYSICS	14.9	51.6	66.6	22.1	7.7	3.7	11.4
145. GEOGRAPHY, PHYSICAL	11.8	51.1	62.8	24.4	8.5	4.3	12.8
146. GEOLOGY	15.8	50.6	66.4	22.6	7.5	3.5	11.0
147. ENGINEERING, GEOLOGICAL	27.3	35.4	62.6	23.7	9.7	4.0	13.6
148. PALEONTOLOGY	23.4	39.8	63.3	23.9	8.8	4.0	12.8
149. REMOTE SENSING	17.9	50.1	68.1	21.6	7.6	2.8	10.3
150. OCEANOGRAPHY	14.2	48.8	63.0	23.6	9.2	4.2	13.4
151. ENGINEERING, OCEAN	43.6	27.2	70.8	20.4	6.2	2.6	8.9
152. METEOROLOGY & ATMOSPH. SCS.	10.9	54.2	65.1	23.5	7.9	3.6	11.4
153 ENGINEERING, AEROSPACE	45.5	20.3	65.8	23.2	7.8	3.2	11.0
154. MINERALOGY	17.3	51.1	68.3	22.0	6.7	2.9	9.6
155. MINING & MINERAL PROCESSING	49.6	24.2	73.7	18.9	5.0	2.3	7.3

### ***XV. AGRICULT. & ENVIRONMENT***

156. AGRICULTURAL ENGINEERING	24.6	34.9	59.5	25.0	10.3	5.2	15.5
157. AGRICULTURE, MULTIDISCIPLINARY	38.0	33.6	71.6	19.3	6.2	2.9	9.1
158. AGRONOMY	26.5	39.7	66.2	22.5	7.4	3.9	11.3
159. LIMNOLOGY	12.7	55.1	67.8	20.9	7.6	3.7	11.3
160. SOIL SCIENCE	17.3	47.9	65.3	22.7	8.0	4.0	12.0
161. BIODIVERSITY CONSERVATION	22.6	46.6	69.2	20.8	6.8	3.2	10.0
162. ENVIRONMENTAL SCIENCES	15.0	52.7	67.7	21.5	7.5	3.3	10.8
163. ENVIRONMENTAL STUDIES	22.7	45.2	67.9	20.9	7.4	3.8	11.2
164. FOOD SCIENCE & TECHNOLOGY	21.5	44.2	65.7	23.0	7.5	3.7	11.3
165. NUTRITION & DIETETICS	12.8	53.7	66.5	22.9	7.0	3.6	10.6
166. AGRIC., DAIRY & ANIMAL SCIENCE	30.4	37.7	68.1	20.6	7.3	4.1	11.4
167. HORTICULTURE	25.1	44.8	69.9	21.5	5.9	2.6	8.5

### ***XVI. BIOLOGY***

#### ***(ORGANISMIC AND SUPRAORG. LEVEL)***

168. ORNITHOLOGY	18.8	50.5	69.4	20.8	7.1	2.8	9.9
169. ZOOLOGY	19.1	45.5	64.6	23.6	8.2	3.6	11.8
170. ENTOMOLOGY	25.4	40.5	65.9	23.7	6.7	3.8	10.5
171. WATER RESOURCES	21.1	46.6	67.7	20.8	7.5	4.0	11.6
172. FISHERIES	17.3	46.1	63.3	23.6	8.9	4.2	13.1
173. MARINE & FRESHWATER BIOLOGY	12.6	50.3	62.9	24.5	8.6	4.0	12.6
174. MICROBIOLOGY	8.2	56.2	64.4	23.7	8.0	3.9	11.9
175. PARASITOLOGY	12.2	56.1	68.3	20.8	7.4	3.5	10.9
176. VIROLOGY	3.5	62.5	65.9	22.8	7.4	3.9	11.2
177. FORESTRY	15.3	52.1	67.4	21.5	7.5	3.6	11.1

178. MYCOLOGY	24.0	45.0	69.0	20.1	7.7	3.1	10.9
179. PLANT SCIENCES	15.8	54.7	70.4	20.4	6.2	3.0	9.2
180. PURE AND APPLIED ECOLOGY	11.4	53.9	65.3	23.5	7.4	3.7	11.1
181. VETERINARY SCIENCES	33.7	37.7	71.5	19.0	6.2	3.3	9.5

#### ***XVII. MULTIDISCIPLINARY***

182. MULTIDISCIPLINARY SCIENCES	42.0	28.1	70.1	20.8	6.1	2.9	9.0
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#### ***XVIII. RESIDUAL SUB-FIELDS***

183. MATERIALS SCIENCE, MULT.	28.0	43.4	71.4	19.8	6.3	2.5	8.8
184. CRYSTALLOGRAPHY	28.8	39.8	68.6	22.5	7.0	1.9	8.9
185. GEOSCIENCES, MULT.	19.6	47.8	67.4	21.6	7.4	3.7	11.0
186. MED., RES. & EXPERIMENTAL	21.3	56.2	77.5	15.7	4.6	2.2	6.8

#### ***XIX. SOCIAL SCIENCES, GENERAL***

187. CRIMINOLOGY & PENOLOGY	31.9	36.5	68.4	20.2	7.6	3.9	11.5
188. LAW	28.8	40.9	69.7	20.6	6.5	3.1	9.6
189. POLITICAL SCIENCE	41.8	29.8	71.6	20.2	5.8	2.4	8.2
190. PUBLIC ADMINISTRATION	34.0	33.9	67.9	21.8	7.1	3.2	10.3
191. ETHNIC STUDIES	47.8	22.4	70.2	20.9	6.4	2.5	8.9
192. FAMILY STUDIES	21.4	42.4	63.8	23.9	8.3	4.0	12.4
193. SOCIAL ISSUES	39.2	31.5	70.7	21.3	5.6	2.5	8.0
194. SOCIAL WORK	31.4	35.7	67.1	21.6	7.5	3.8	11.3
195. SOCIOLOGY	37.3	36.9	74.2	18.4	5.1	2.3	7.4
196. WOMEN'S STUDIES	39.0	31.6	70.6	20.0	6.4	2.9	9.4
197. EDUCATION & EDUCATIONAL RES.	38.0	34.1	72.1	20.0	5.5	2.4	7.9
198. EDUCATION, SPECIAL	23.7	45.2	68.9	22.1	6.0	3.0	9.0
199. AREA STUDIES	47.7	24.9	72.6	17.7	7.1	2.6	9.7
200. GEOGRAPHY	23.4	47.3	70.7	20.7	6.0	2.5	8.6
201. PLANNING & DEVELOPMENT	28.6	34.9	63.5	24.1	8.5	3.9	12.4
202. TRANSPORTATION	27.6	34.9	62.5	26.0	7.1	4.5	11.6
2003 URBAN STUDIES	26.0	45.8	71.8	18.3	6.8	3.1	9.9
204. ETHICS	40.8	31.5	72.3	18.2	6.3	3.2	9.5
205. MEDICAL ETHICS	19.5	44.7	64.2	24.2	8.2	3.4	11.7
206. ANTHROPOLOGY	36.3	32.0	68.3	20.4	7.3	4.0	11.3
207. COMMUNICATION	27.7	33.4	61.2	26.7	8.0	4.2	12.2
208. DEMOGRAPHY	21.8	49.3	71.1	19.8	6.5	2.6	9.1
209. HISTORY OF SOCIAL SCIENCES	43.1	23.7	66.8	22.0	6.9	4.3	11.2
210. INFORMATION SC. & LIBRARY SC.	43.0	29.9	72.9	19.6	5.3	2.2	7.5
211. INTERNATIONAL RELATIONS	45.1	29.2	74.2	17.7	5.5	2.5	8.0
212. LINGUISTICS	25.9	40.7	66.7	21.4	7.8	4.2	12.0
213. SOCIAL SCIENCES, INTERD.	39.5	33.6	73.2	18.3	5.7	2.9	8.5

#### ***XX. ECONOMICS & BUSINESS***

214. AGRICULTURAL ECONOMICS & POLICY	29.3	34.7	64.1	22.5	9.5	3.9	13.4
215. ECONOMICS	31.1	41.2	72.3	19.4	5.6	2.7	8.3
216. INDUSTRIAL RELATIONS & LABOR	30.4	39.8	70.2	18.9	8.1	2.8	10.9
217. BUSINESS	24.1	43.3	67.3	22.1	7.1	3.5	10.6
218. BUSINESS, FINANCE	29.2	41.0	70.2	20.7	5.8	3.3	9.1
219. MANAGEMENT	26.0	45.8	71.8	19.0	6.3	3.0	9.3

<b>Mean Value By Category</b>	23.6	44.7	68.3	21.5	7.0	3.2	10.2
<b>Standard Deviation</b>	12.3	11.3	3.4	2.1	1.1	0.65	1.6
<b>Coefficient of Variation</b>	0.51	0.24	0.05	0.10	0.15	0.20	0.16

**Table A.II. Characteristic Scales and Scores for the Original, Un-normalized Distribution at the Sub-field Level According to the Fractional Strategy**

	Percentage of Citations By Category:				
	2	3	4	5	4+5
<b><i>I. BIOSCIENCES</i></b>					
1. BIOLOGY	21.3	33.5	22.7	22.4	45.1
2. BIOLOGY, MISCELLANEOUS	24.1	31.5	21.2	23.2	44.4
3. EVOLUTIONARY BIOLOGY	27.6	34.2	19.8	18.4	38.2
4. BIOCHEMICAL RESEARCH METHODS	29.4	33.7	19.2	17.7	36.9
5. BIOCHEMISTRY & MOLECULAR BIOLOGY	27.1	33.5	20.1	19.4	39.5
6. BIOPHYSICS	25.6	33.2	20.4	20.8	41.2
7. CELL BIOLOGY	24.4	32.2	21.5	22.0	43.4
8. GENETICS & HEREDITY	25.1	31.3	20.5	23.1	43.6
9. DEVELOPMENTAL BIOLOGY	27.1	32.8	20.7	19.4	40.1
<b><i>II. BIOMEDICAL RESEARCH</i></b>					
10. PATHOLOGY	22.8	32.9	21.7	22.6	44.3
11. ANATOMY & MORPHOLOGY	25.1	35.3	20.5	19.2	39.7
12. ENGINEERING, BIOMEDICAL	24.0	32.1	22.3	21.6	43.9
13. BIOTECH. & APPLIED MICROBIOLOGY	23.7	33.7	20.9	21.7	42.6
14. MEDICAL LABORATORY TECHNOLOGY	23.6	33.8	20.8	21.8	42.6
15. MICROSCOPY	27.3	34.0	20.2	18.5	38.7
16. PHARMACOLOGY & PHARMACY	26.1	33.0	19.9	21.0	41.0
17. TOXICOLOGY	28.0	33.7	19.8	18.5	38.3
18. PHYSIOLOGY	25.7	33.6	20.9	19.9	40.8
<b><i>III. CLINICAL MEDICINE I (INTERNAL)</i></b>					
19. CARDIAC & CARDIOVASCULAR SYSTEMS	21.2	33.2	22.1	23.6	45.6
20. RESPIRATORY SYSTEM	23.1	32.9	22.7	21.3	44.0
21. ENDOCRINOLOGY & METABOLISM	26.9	33.2	20.6	19.3	39.9
22. ANESTHESIOLOGY	22.7	34.2	22.0	21.1	43.1
23. CRITICAL CARE MEDICINE	25.7	33.5	20.3	20.6	40.9
24. EMERGENCY MEDICINE	22.6	33.8	21.1	22.6	43.6
25. GASTROENTEROLOGY & HEPATOLOGY	23.2	33.0	21.5	22.3	43.8
26. MEDICINE, GENERAL & INTERNAL	15.7	28.7	24.3	31.2	55.5
27. TROPICAL MEDICINE	25.2	32.0	21.7	21.1	42.8
28. HEMATOLOGY	24.2	32.5	21.4	21.8	43.2
29. ONCOLOGY	25.3	32.6	21.1	21.0	42.1
30. ALLERGY	19.5	34.4	23.4	22.8	46.1
31. IMMUNOLOGY	25.8	33.1	20.3	20.8	41.1
32. INFECTIOUS DISEASES	25.3	33.8	20.8	20.1	40.9
<b><i>IV. CLIN. MED. II (NON-INTERNAL)</i></b>					
33. GERIATRICS & GERONTOLOGY	23.1	34.7	21.5	20.7	42.2
34. OBSTETRICS & GYNECOLOGY	23.3	34.3	21.5	21.0	42.4
35. ANDROLOGY	26.7	33.4	19.4	20.5	39.9
36. REPRODUCTIVE BIOLOGY	29.0	33.5	19.3	18.2	37.5
37. GERONTOLOGY	21.5	32.9	21.8	23.9	45.6
38. DENTISTRY, ORAL SURGERY	27.3	31.5	22.1	19.1	41.2
39. DERMATOLOGY	25.3	32.8	21.6	20.3	41.9
40. UROLOGY & NEPHROLOGY	23.9	34.2	21.3	20.7	41.9
41. OTORHINOLARYNGOLOGY	19.2	36.1	23.0	21.7	44.6



42. OPHTHALMOLOGY	21.5	34.2	22.5	21.8	44.2
43. INTEGRATIVE & COMPLEMENTARY MEDICINE	17.7	35.4	26.1	20.8	46.9
44. CLINICAL NEUROLOGY	23.4	32.6	21.3	22.8	44.0
45. PSYCHIATRY	21.6	32.6	22.2	23.6	45.8
46. RADIOLOGY, NUCLEAR MED. & IMAGING	22.8	33.1	21.7	22.4	44.0
47. ORTHOPEDICS	23.3	32.3	21.2	23.2	44.4
48. RHEUMATOLOGY	24.0	33.3	22.3	20.4	42.7
49. SPORT SCIENCES	20.5	32.9	24.0	22.6	46.6
50. SURGERY	23.8	32.5	22.0	21.7	43.7
51. TRANSPLANTATION	21.8	34.0	22.0	22.3	44.3
52. PERIPHERAL VASCULAR DISEASE	24.5	33.3	21.2	21.0	42.2
53. PEDIATRICS	19.9	34.0	22.9	23.2	46.1

#### ***V. CL MED. III (HEALTH & OTHER SCS.)***

54. HEALTH CARE SCIENCES & SERVICES	22.8	35.6	21.5	20.0	41.5
55. HEALTH POLICY & SERVICES	22.5	34.0	21.4	22.2	43.6
56. MEDICINE, LEGAL	24.7	32.2	22.4	20.7	43.1
57. NURSING	16.4	40.9	21.8	20.9	42.7
58. PUBLIC, ENVIRON. & OCCUP. HEALTH	24.7	33.6	20.8	21.0	41.8
59. REHABILITATION	18.8	34.0	22.3	24.9	47.2
60. SUBSTANCE ABUSE	26.7	33.0	20.9	19.4	40.3
61. EDUCATION, SCIENTIFIC DISCIPLINES	16.8	31.6	24.6	27.1	51.7
62. MEDICAL INFORMATICS	17.6	36.4	23.8	22.2	46.0

#### ***VI. NEUROSCIENCE & BEHAVIOR***

63. NEUROIMAGING	22.3	32.9	21.4	23.4	44.8
64. NEUROSCIENCES	28.0	31.8	19.6	20.6	40.2
65. BEHAVIORAL SCIENCES	27.8	33.0	20.4	18.8	39.1
66. PSYCHOLOGY, BIOLOGICAL	30.8	34.1	18.4	16.7	35.1
67. PSYCHOLOGY	23.7	33.2	21.9	21.2	43.1
68. PSYCHOLOGY, APPLIED	21.8	33.7	21.2	23.4	44.5
69. PSYCHOLOGY, CLINICAL	22.5	33.1	21.9	22.5	44.4
70. PSYCHOLOGY, DEVELOPMENTAL	26.9	33.1	20.3	19.7	40.0
71. PSYCHOLOGY, EDUCATIONAL	19.8	32.8	24.9	22.5	47.4
72. PSYCHOLOGY, EXPERIMENTAL	22.0	32.8	22.6	22.6	45.2
73. PSYCHOLOGY, MATHEMATICAL	24.5	34.5	18.8	22.2	41.0
74. PSYCHOLOGY, MULTIDISCIPLINARY	21.3	32.3	21.7	24.7	46.4
75. PSYCHOLOGY, PSYCHOANALYSIS	18.7	35.1	24.2	22.0	46.2
76. PSYCHOLOGY, SOCIAL	24.8	32.0	21.7	21.5	43.2
77. SOCIAL SCIENCES, BIOMEDICAL	26.1	32.5	20.3	21.2	41.4

#### ***VII. CHEMISTRY***

78. CHEMISTRY, MULTIDISCIPLINARY	18.1	33.1	24.0	24.8	48.8
79. CHEMISTRY, INORGANIC & NUCLEAR	21.8	33.8	22.8	21.6	44.4
80. CHEMISTRY, ANALYTICAL	23.8	33.2	21.7	21.3	43.0
81. CHEMISTRY, APPLIED	17.8	36.7	22.6	23.0	45.6
82. ENGINEERING, CHEMICAL	23.1	32.8	22.8	21.3	44.1
83. CHEMISTRY, MEDICINAL	25.2	32.8	21.8	20.1	41.9
84. CHEMISTRY, ORGANIC	23.4	35.2	22.0	19.3	41.3
85. CHEMISTRY, PHYSICAL	23.2	34.3	21.5	21.1	42.5
86. ELECTROCHEMISTRY	21.3	33.0	23.3	22.4	45.7
87. POLYMER SCIENCE	24.2	34.0	20.6	21.2	41.8

#### ***VIII. PHYSICS***

88. PHYSICS, MULTIDISCIPLINARY	18.2	31.9	24.0	26.0	50.0
89. SPECTROSCOPY	23.2	33.0	21.3	22.5	43.8
90. ACOUSTICS	18.4	33.9	22.5	25.3	47.7
91. OPTICS	22.9	32.6	21.9	22.6	44.5
92. PHYSICS, APPLIED	22.8	33.7	21.6	21.9	43.5
93. PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	28.0	34.5	18.8	18.8	37.5
94. THERMODYNAMICS (CLASSICAL PHYSICS)	25.3	33.6	21.5	19.7	41.2
95. PHYSICS, MATHEMATICAL	22.1	34.3	21.8	21.7	43.5
96. PHYSICS, NUCLEAR	19.2	35.0	22.8	23.0	45.8
97. PHYSICS, PARTICLES & FIELDS	20.8	32.9	21.8	24.4	46.3
98. PHYSICS, CONDENSED MATTER	23.0	33.7	21.8	21.5	43.3
99. PHYSICS OF SOLIDS, FLUIDS & PLASMAS	23.3	32.7	22.0	22.0	44.0

#### ***IX. SPACE SCIENCES***

100. ASTRONOMY & ASTROPHYSICS	22.6	34.0	21.4	22.0	43.5
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#### ***X. MATHEMATICS***

101. MATHEMATICS, APPLIED	17.0	33.2	25.8	24.0	49.8
102. STATISTICS & PROBABILITY	20.6	34.4	21.8	23.2	45.0
103. MATHEMATICS, INTERDISC. APPL.	25.8	33.5	19.3	21.4	40.7
104. SOCIAL SCIENCES, MATH. METHODS	18.1	34.6	22.1	25.2	47.3
105. PURE MATHEMATICS	10.8	35.6	27.1	26.5	53.6

#### ***XI. COMPUTER SCIENCE***

106. COMP. SC, ARTIFICIAL INTELLIGENCE.	18.2	34.1	22.9	24.8	47.7
107. COMPUTER SCIENCE, CYBERNETICS	16.0	35.7	23.7	24.6	48.3
108. COMP SC, HARDWARE & ARCHITECTURE	15.5	32.5	23.9	28.1	52.0
109. COMP. SC., INFORMATION SYSTEMS	14.4	33.1	24.5	28.0	52.5
110. COMP. SC., INTERDIS. APPLICATIONS	18.0	33.5	23.1	25.4	48.5
111. COMP. SC., SOFTWARE ENGINEERING	16.4	35.4	22.3	26.0	48.2
112. COMP. SC, THEORY & METHODS	18.9	36.6	21.7	22.8	44.5
113. MATHEMATICAL & COMPUT. BIOLOGY	27.6	33.7	17.8	21.0	38.8

#### ***XII. ENGINEERING***

114. ENG., ELECTRICAL & ELECTRONIC	19.5	33.9	22.5	24.1	46.7
115. TELECOMMUNICATIONS	14.0	36.5	23.7	25.8	49.5
116. CONSTRUCTION & BUILDING TECH.	20.4	32.2	25.0	22.4	47.4
117. ENGINEERING, CIVIL	19.8	37.5	22.0	20.7	42.7
118. ENGINEERING, ENVIRONMENTAL	21.0	33.7	22.8	22.5	45.3
119. ENGINEERING, MARINE	19.6	31.5	21.2	27.8	49.0
120. TRANSPORTATION SC. & TECHNOLOGY	12.6	32.6	28.6	26.2	54.8
121. ENGINEERING, INDUSTRIAL	22.1	32.4	24.7	20.9	45.5
122. ENGINEERING, MANUFACTURING	21.2	32.1	26.1	20.7	46.8
123. ENGINEERING, MECHANICAL	18.7	35.8	23.3	22.2	45.5
124. MECHANICS	19.1	33.3	22.7	24.9	47.6
125. ROBOTICS	22.4	35.7	21.8	20.0	41.8
126. INSTRUMENTS & INSTRUMENTATION	18.7	32.9	23.8	24.6	48.4
127. IMAGING SC. & PHOTOGRAPHIC TECH.	21.4	31.4	23.4	23.9	47.2
128. ENERGY & FUELS	19.3	36.7	22.9	21.2	44.0
129. NUCLEAR SCIENCE & TECHNOLOGY	16.5	33.6	26.0	23.9	49.9
130. ENGINEERING, PETROLEUM	0.0	37.2	25.3	37.5	62.8
131. AUTOMATION & CONTROL SYSTEMS	15.2	33.6	25.5	25.7	51.2
132. ENGINEERING, MULTIDISCIPLINARY	17.1	36.4	22.6	23.9	46.5
133. ERGONOMICS	26.8	33.9	20.4	18.9	39.3

134. OPERATIONS RES. & MANAG. SCIENCE	17.3	36.4	24.0	22.2	46.2
<b><i>XIII. MATERIALS SCIENCE</i></b>					
135. MATERIALS SCIENCE, BIOMATERIALS	26.0	32.9	21.4	19.7	41.1
136. MATERIALS SCIENCE, CERAMICS	16.9	36.5	24.0	22.5	46.6
137. MAT. SC., CHARAC. & TESTING	12.6	35.9	24.4	27.0	51.5
138. MAT. SC., COATINGS & FILMS	23.2	33.8	22.2	20.8	43.0
139. MATERIALS SCIENCE, COMPOSITES	16.5	37.0	24.4	22.1	46.5
140. MATERIALS SCIENCE, PAPER & WOOD	11.0	36.5	25.7	26.9	52.5
141. MATERIALS SCIENCE, TEXTILES	12.9	38.2	22.7	26.2	48.9
142. METALLURGY & METALL. ENGIN.	13.9	34.3	24.8	27.1	51.9
143. NANOSCIENCE & NANOTECHNOLOGY	23.4	34.2	21.2	21.3	42.4
<b><i>XIV. GEOSCIENCES</i></b>					
144. GEOCHEMISTRY & GEOPHYSICS	24.0	33.4	21.9	20.7	42.6
145. GEOGRAPHY, PHYSICAL	23.6	33.8	21.4	21.3	42.6
146. GEOLOGY	24.5	34.7	21.5	19.3	40.8
147. ENGINEERING, GEOLOGICAL	18.6	33.8	25.5	22.1	47.6
148. PALEONTOLOGY	18.5	33.8	24.4	23.3	47.7
149. REMOTE SENSING	24.2	32.9	22.8	20.1	42.9
150. OCEANOGRAPHY	22.7	33.4	23.5	20.3	43.9
151. ENGINEERING, OCEAN	14.5	35.0	24.9	25.6	50.5
152. METEOROLOGY & ATMOSPH. SCS.	23.2	33.3	22.1	21.4	43.5
153 ENGINEERING, AEROSPACE	11.8	36.7	27.4	24.1	51.5
154. MINERALOGY	26.2	34.8	20.3	18.7	38.9
155. MINING & MINERAL PROCESSING	14.9	37.4	22.6	25.1	47.7
<b><i>XV. AGRICULT. &amp; ENVIRONMENT</i></b>					
156. AGRICULTURAL ENGINEERING	16.9	32.3	25.1	25.7	50.9
157. AGRICULTURE, MULTIDISCIPLINARY	17.6	34.3	23.7	24.4	48.1
158. AGRONOMY	19.6	33.9	22.2	24.3	46.5
159. LIMNOLOGY	26.3	32.4	22.0	19.3	41.3
160. SOIL SCIENCE	24.4	34.0	21.7	19.9	41.6
161. BIODIVERSITY CONSERVATION	21.8	33.8	22.3	22.1	44.5
162. ENVIRONMENTAL SCIENCES	24.8	32.6	21.9	20.7	42.6
163. ENVIRONMENTAL STUDIES	24.6	32.2	21.3	21.9	43.2
164. FOOD SCIENCE & TECHNOLOGY	21.3	35.1	22.0	21.5	43.6
165. NUTRITION & DIETETICS	22.6	33.9	20.9	22.6	43.5
166. AGRIC., DAIRY & ANIMAL SCIENCE	19.2	32.5	22.9	25.4	48.3
167. HORTICULTURE	24.4	35.7	20.2	19.7	39.9
<b><i>XVI. BIOLOGY</i></b>					
<b><i>(ORGANISMIC AND SUPRAORG. LEVEL)</i></b>					
168. ORNITHOLOGY	27.0	32.9	20.9	19.1	40.0
169. ZOOLOGY	21.2	34.0	23.3	21.5	44.8
170. ENTOMOLOGY	21.1	37.1	20.2	21.6	41.8
171. WATER RESOURCES	24.5	32.3	21.4	21.8	43.2
172. FISHERIES	23.2	33.6	22.9	20.3	43.3
173. MARINE & FRESHWATER BIOLOGY	24.5	34.8	21.9	18.8	40.7
174. MICROBIOLOGY	25.2	33.5	20.9	20.4	41.3
175. PARASITOLOGY	28.0	31.9	20.6	19.4	40.0
176. VIROLOGY	29.6	32.8	18.9	18.7	37.6
177. FORESTRY	26.8	32.9	20.9	19.5	40.3
178. MYCOLOGY	21.8	32.1	24.7	21.4	46.1

179. PLANT SCIENCES	24.9	32.9	20.9	21.3	42.2
180. PURE AND APPLIED ECOLOGY	25.3	34.9	20.2	19.6	39.8
181. VETERINARY SCIENCES	21.2	33.3	21.6	23.9	45.5

***XVII. MULTIDISCIPLINARY***

182. MULTIDISCIPLINARY SCIENCES	12.9	32.9	24.2	30.0	54.2
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***XVIII. RESIDUAL SUB-FIELDS***

183. MATERIALS SCIENCE, MULT.	21.5	32.7	22.6	23.3	45.9
184. CRYSTALLOGRAPHY	18.4	34.3	24.5	22.8	47.3
185. GEOSCIENCES, MULT.	22.7	33.2	21.7	22.4	44.1
186. MED., RES. & EXPERIMENTAL	19.8	29.6	23.1	27.4	50.5

***XIX. SOCIAL SCIENCES, GENERAL***

187. CRIMINOLOGY & PENOLOGY	18.5	32.0	24.8	24.8	49.6
188. LAW	19.9	33.6	22.9	23.6	46.4
189. POLITICAL SCIENCE	16.7	35.9	23.8	23.6	47.4
190. PUBLIC ADMINISTRATION	18.9	35.2	24.3	21.6	46.0
191. ETHNIC STUDIES	13.9	34.4	25.6	26.1	51.8
192. FAMILY STUDIES	19.3	33.1	24.0	23.6	47.6
193. SOCIAL ISSUES	16.9	36.6	22.2	24.3	46.5
194. SOCIAL WORK	21.2	34.3	22.3	22.3	44.5
195. SOCIOLOGY	21.4	35.3	21.1	22.2	43.3
196. WOMEN'S STUDIES	18.8	34.7	23.3	23.2	46.5
197. EDUCATION & EDUCATIONAL RES.	21.7	37.0	21.3	20.0	41.3
198. EDUCATION, SPECIAL	24.3	36.4	19.8	19.5	39.3
199. AREA STUDIES	20.0	33.3	26.5	20.2	46.7
200. GEOGRAPHY	24.9	34.8	20.6	19.7	40.3
201. PLANNING & DEVELOPMENT	16.8	32.9	24.8	25.4	50.3
202. TRANSPORTATION	16.8	38.2	20.9	24.1	45.0
2003 URBAN STUDIES	26.7	30.8	21.4	21.1	42.5
204. ETHICS	21.9	33.4	22.4	22.3	44.7
205. MEDICAL ETHICS	21.2	34.8	23.6	20.4	44.0
206. ANTHROPOLOGY	17.1	31.8	23.8	27.3	51.1
207. COMMUNICATION	16.0	36.8	22.8	24.3	47.2
208. DEMOGRAPHY	25.8	32.5	22.0	19.6	41.6
209. HISTORY OF SOCIAL SCIENCES	17.3	37.6	21.7	23.4	45.1
210. INFORMATION SC. & LIBRARY SC.	17.5	36.1	22.8	23.6	46.4
211. INTERNATIONAL RELATIONS	16.4	31.9	24.0	27.7	51.7
212. LINGUISTICS	19.9	31.6	23.1	25.5	48.5
213. SOCIAL SCIENCES, INTERD.	21.2	33.6	21.9	23.3	45.2

***XX. ECONOMICS & BUSINESS***

214. AGRICULTURAL ECONOMICS & POLICY	19.2	33.2	26.5	21.1	47.6
215. ECONOMICS	21.1	32.8	21.2	24.9	46.1
216. INDUSTRIAL RELATIONS & LABOR	23.4	32.2	25.2	19.2	44.4
217. BUSINESS	19.1	33.4	23.7	23.8	47.4
218. BUSINESS, FINANCE	17.8	33.4	21.6	27.3	48.8
219. MANAGEMENT	22.2	31.8	22.7	23.4	46.0

<b>Mean Value By Category</b>	21.5	33.8	22.3	22.4	44.7
<b>Standard Deviation</b>	4.20	1.60	1.76	2.62	3.87
<b>Coefficient of Variation</b>	0.20	0.05	0.08	0.12	0.09

**Table B. Low- and High-impact Values for the Original, Un-normalized Distribution at the Sub-field Level According to the Multiplicative and the Fractional Strategies**

	Low-impact:			High-impact:		
	Mult. (1)	Frac. (2)	(3) = (1) – (2) In %	Mult. (4)	Frac. (5)	(6) = (4) – (5) In %
<i>I. BIOSCIENCES</i>						
1. BIOLOGY	0.48	0.48	-1.31	0.56	0.61	-9.19
2. BIOLOGY, MISCELLANEOUS	0.44	0.47	-6.60	0.50	0.44	14.95
3. EVOLUTIONARY BIOLOGY	0.37	0.37	0.92	0.39	0.54	-26.80
4. BIOCHEMICAL RESEARCH METHODS	0.39	0.38	1.53	5.16	3.67	40.77
5. BIOCHEMISTRY & MOLECULAR BIOLOGY	0.40	0.39	2.41	1.13	0.91	24.31
6. BIOPHYSICS	0.39	0.39	-0.65	1.27	0.88	44.46
7. CELL BIOLOGY	0.44	0.44	-1.32	0.92	0.90	2.66
8. GENETICS & HEREDITY	0.41	0.43	-4.27	1.07	1.27	-15.69
9. DEVELOPMENTAL BIOLOGY	0.42	0.39	7.66	0.63	0.40	59.46
<i>II. BIOMEDICAL RESEARCH</i>						
10. PATHOLOGY	0.44	0.44	-0.04	0.76	0.67	14.00
11. ANATOMY & MORPHOLOGY	0.42	0.41	2.24	0.40	0.52	-22.44
12. ENGINEERING, BIOMEDICAL	0.43	0.41	5.57	0.37	0.45	-18.00
13. BIOTECH. & APPLIED MICROBIOLOGY	0.43	0.42	1.41	2.09	2.15	-2.72
14. MEDICAL LABORATORY TECHNOLOGY	0.44	0.45	-2.16	0.78	0.71	9.00
15. MICROSCOPY	0.42	0.41	4.27	0.32	0.43	-26.62
16. PHARMACOLOGY & PHARMACY	0.41	0.42	-2.59	0.56	0.50	12.15
17. TOXICOLOGY	0.40	0.41	-2.06	0.43	0.45	-5.18
18. PHYSIOLOGY	0.37	0.38	-1.35	0.23	0.21	12.01
<i>III. CLINICAL MEDICINE I (INTERNAL)</i>						
19. CARDIAC & CARDIOVASCULAR SYSTEM	0.47	0.46	0.59	1.28	1.20	7.28
20. RESPIRATORY SYSTEM	0.41	0.41	-0.58	0.48	0.47	2.64
21. ENDOCRINOLOGY & METABOLISM	0.38	0.38	0.76	0.61	0.63	-2.73
22. ANESTHESIOLOGY	0.45	0.42	7.57	0.40	0.48	-15.19
23. CRITICAL CARE MEDICINE	0.44	0.41	5.77	0.52	0.59	-12.35
24. EMERGENCY MEDICINE	0.44	0.44	-0.78	0.63	0.51	23.69
25. GASTROENTEROLOGY & HEPATOLOGY	0.43	0.44	-2.14	0.91	0.88	4.31
26. MEDICINE, GENERAL & INTERNAL	0.55	0.56	-1.23	20.68	22.28	-7.18
27. TROPICAL MEDICINE	0.44	0.43	1.84	0.36	0.38	-5.68
28. HEMATOLOGY	0.43	0.43	-0.45	0.78	0.72	8.70
29. ONCOLOGY	0.40	0.40	0.06	1.05	1.15	-9.39
30. ALLERGY	0.46	0.48	-3.81	0.48	0.54	-10.56
31. IMMUNOLOGY	0.42	0.41	2.36	0.96	0.82	17.10
32. INFECTIOUS DISEASES	0.40	0.40	0.11	0.45	0.46	-3.26
<i>IV. CLIN. MED. II (NON-INTERNAL)</i>						
33. GERIATRICS & GERONTOLOGY	0.41	0.44	-5.41	0.41	0.38	7.78
34. OBSTETRICS & GYNECOLOGY	0.42	0.44	-3.00	0.49	0.47	4.58
35. ANDROLOGY	0.41	0.40	0.94	0.32	0.33	-3.52
36. REPRODUCTIVE BIOLOGY	0.38	0.37	1.08	0.27	0.25	7.10
37. GERONTOLOGY	0.44	0.46	-4.58	0.45	0.40	11.75
38. DENTISTRY, ORAL SURGERY	0.40	0.41	-0.85	0.37	0.37	-1.34
39. DERMATOLOGY	0.44	0.43	0.96	0.53	0.60	-10.69

40. UROLOGY & NEPHROLOGY	0.45	0.45	-0.08	0.69	0.74	-6.18
41. OTORHINOLARYNGOLOGY	0.43	0.43	1.67	0.31	0.39	-19.72
42. OPHTHALMOLOGY	0.45	0.45	-0.33	0.60	0.63	-5.78
43. INTEGRATIVE & COMPLEMENTARY MEDICINE	0.41	0.43	-4.60	0.30	0.54	-44.79
44. CLINICAL NEUROLOGY	0.44	0.44	0.06	0.69	0.81	-15.01
45. PSYCHIATRY	0.45	0.46	-0.65	0.58	0.73	-19.99
46. RADIOLOGY, NUCLEAR MED. & IMAGING	0.43	0.45	-3.71	0.82	0.64	29.45
47. ORTHOPEDICS	0.44	0.43	2.47	0.48	0.60	-21.06
48. RHEUMATOLOGY	0.42	0.42	0.01	0.71	0.73	-2.24
49. SPORT SCIENCES	0.43	0.45	-3.96	0.40	0.41	-2.41
50. SURGERY	0.46	0.46	-0.74	0.61	0.61	-0.51
51. TRANSPLANTATION	0.45	0.45	0.00	0.78	0.75	4.94
52. PERIPHERAL VASCULAR DISEASE	0.44	0.43	0.68	0.86	0.94	-9.15
53. PEDIATRICS	0.46	0.46	0.84	0.71	0.78	-9.01

#### ***V. CL. MED. III (HEALTH & OTHERS)***

54. HEALTH CARE SCIENCES & SERVICES	0.44	0.45	-2.68	0.55	0.51	8.40
55. HEALTH POLICY & SERVICES	0.41	0.43	-4.98	0.74	0.66	12.77
56. MEDICINE, LEGAL	0.44	0.43	1.99	0.41	0.39	6.54
57. NURSING	0.45	0.45	-0.24	0.30	0.28	10.12
58. PUBLIC, ENVIRON. & OCCUP. HEALTH	0.43	0.42	2.60	0.51	0.55	-8.65
59. REHABILITATION	0.46	0.44	2.52	0.33	0.48	-31.31
60. SUBSTANCE ABUSE	0.39	0.39	-0.30	0.25	0.26	-3.54
61. EDUCATION, SCIENTIFIC DISCIPLINES	0.47	0.48	-0.29	0.93	0.93	0.87
62. MEDICAL INFORMATICS	0.47	0.48	-2.04	1.25	0.96	30.41

#### ***VI. NEUROSCIENCE & BEHAVIOR***

63. NEUROIMAGING	0.47	0.47	0.00	0.75	0.75	0.00
64. NEUROSCIENCES	0.40	0.39	2.00	0.59	0.63	-6.75
65. BEHAVIORAL SCIENCES	0.33	0.33	1.10	0.25	0.26	-1.94
66. PSYCHOLOGY, BIOLOGICAL	0.36	0.37	-3.13	0.37	0.35	7.63
67. PSYCHOLOGY	0.40	0.42	-4.41	0.35	0.36	-1.89
68. PSYCHOLOGY, APPLIED	0.42	0.44	-5.12	0.39	0.31	26.62
69. PSYCHOLOGY, CLINICAL	0.42	0.42	0.00	0.56	0.64	-12.88
70. PSYCHOLOGY, DEVELOPMENTAL	0.42	0.41	2.67	0.39	0.43	-7.85
71. PSYCHOLOGY, EDUCATIONAL	0.47	0.47	0.43	0.52	0.63	-17.84
72. PSYCHOLOGY, EXPERIMENTAL	0.42	0.45	-7.51	0.52	0.45	14.54
73. PSYCHOLOGY, MATHEMATICAL	0.45	0.44	2.87	0.48	0.52	-7.67
74. PSYCHOLOGY, MULTIDISCIPLINARY	0.50	0.52	-4.25	1.39	2.01	-31.12
75. PSYCHOLOGY, PSYCHOANALYSIS	0.54	0.55	-1.85	0.87	1.21	-28.24
76. PSYCHOLOGY, SOCIAL	0.43	0.44	-3.86	0.55	0.46	18.64
77. SOCIAL SCIENCES, BIOMEDICAL	0.43	0.43	-0.69	0.57	0.60	-4.27

#### ***VII. CHEMISTRY***

78. CHEMISTRY, MULTIDISCIPLINARY	0.51	0.51	0.52	1.01	1.07	-5.55
79. CHEMISTRY, INORGANIC & NUCLEAR	0.42	0.44	-4.06	0.44	0.35	24.29
80. CHEMISTRY, ANALYTICAL	0.42	0.43	-4.13	0.68	0.61	12.64
81. CHEMISTRY, APPLIED	0.45	0.49	-7.49	0.38	0.62	-39.45
82. ENGINEERING, CHEMICAL	0.49	0.47	2.90	0.54	0.72	-25.75
83. CHEMISTRY, MEDICINAL	0.39	0.39	-0.33	0.43	0.44	-1.60
84. CHEMISTRY, ORGANIC	0.38	0.38	-0.87	0.40	0.42	-5.51
85. CHEMISTRY, PHYSICAL	0.42	0.43	-1.19	0.54	0.52	5.33
86. ELECTROCHEMISTRY	0.41	0.43	-4.48	0.32	0.38	-17.23
87. POLYMER SCIENCE	0.43	0.45	-2.58	0.71	0.58	23.07

### ***VIII. PHYSICS***

88. PHYSICS, MULTIDISCIPLINARY	0.53	0.53	0.60	3.07	3.33	-7.69
89. SPECTROSCOPY	0.45	0.43	4.08	0.60	0.68	-10.70
90. ACOUSTICS	0.44	0.44	-0.53	0.50	0.47	6.65
91. OPTICS	0.47	0.47	-0.61	0.87	0.89	-1.45
92. PHYSICS, APPLIED	0.45	0.45	0.11	1.23	1.23	0.43
93. PHYSICS, ATOMIC, MOLECULAR & CHEMICAL	0.39	0.38	3.61	0.43	0.41	4.80
94. THERMODYNAMICS (CLASSICAL PHYSICS)	0.42	0.42	-0.56	0.54	0.51	5.93
95. PHYSICS, MATHEMATICAL	0.46	0.45	1.24	0.71	0.73	-2.85
96. PHYSICS, NUCLEAR	0.47	0.50	-4.70	1.18	0.82	43.29
97. PHYSICS, PARTICLES & FIELDS	0.49	0.50	-2.07	3.72	3.99	-6.60
98. PHYSICS, CONDENSED MATTER	0.46	0.46	0.67	1.09	1.04	4.73
99. PHYSICS OF SOLIDS, FLUIDS & PLASMAS	0.41	0.40	2.54	0.38	0.49	-22.14

### ***IX. SPACE SCIENCES***

100. ASTRONOMY & ASTROPHYSICS	0.45	0.44	3.98	0.97	1.03	-5.54
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### ***X. MATHEMATICS***

101. MATHEMATICS, APPLIED	0.50	0.49	1.49	0.82	0.84	-1.85
102. STATISTICS & PROBABILITY	0.50	0.51	-1.05	14.77	7.65	93.09
103. MATHEMATICS, INTERDISC. APPL.	0.45	0.45	-1.04	0.74	0.69	6.74
104. SOCIAL SCIENCES, MATH. METHODS	0.47	0.48	-1.36	0.85	0.78	9.37
105. PURE MATHEMATICS	0.51	0.52	-0.41	0.75	0.74	0.39

### ***XI. COMPUTER SCIENCE***

106. COMP. SC, ARTIFICIAL INTELLIGENCE	0.50	0.54	-6.70	2.09	1.81	15.80
107. COMPUTER SCIENCE, CYBERNETICS	0.54	0.58	-6.93	1.00	1.02	-2.12
108. COMP SC, HARDWARE & ARCHITECTURE	0.52	0.55	-5.06	2.85	2.27	25.60
109. COMP. SC., INFORMATION SYSTEMS	0.52	0.54	-3.70	3.32	2.77	20.05
110. COMP. SC., INTERDISC. APPLICATIONS	0.50	0.48	4.00	12.86	9.93	29.51
111. COMP. SC., SOFTWARE ENGINEERING	0.53	0.54	-1.93	1.09	0.95	14.87
112. COMP. SC, THEORY & METHODS	0.54	0.58	-6.83	2.76	1.94	42.19
113. MATHEMATICAL & COMPUT. BIOLOGY	0.41	0.40	2.77	15.53	11.77	31.96

### ***XII. ENGINEERING***

114. ENG., ELECTRICAL & ELECTRONIC	0.50	0.51	-3.15	1.39	1.28	8.06
115. TELECOMMUNICATIONS	0.56	0.58	-3.86	1.98	1.75	13.00
116. CONSTRUCTION & BUILDING TECH.	0.48	0.49	-0.44	0.33	0.34	-3.71
117. ENGINEERING, CIVIL	0.53	0.51	3.23	0.56	1.01	-44.66
118. ENGINEERING, ENVIRONMENTAL	0.46	0.47	-2.31	0.77	0.73	6.26
119. ENGINEERING, MARINE	0.65	0.64	2.01	0.53	0.56	-4.47
120. TRANSPORTATION SC. & TECHNOLOGY	0.60	0.64	-5.07	1.65	1.29	28.55
121. ENGINEERING, INDUSTRIAL	0.52	0.49	6.59	0.32	0.68	-53.24
122. ENGINEERING, MANUFACTURING	0.48	0.49	-2.08	0.33	0.33	-1.18
123. ENGINEERING, MECHANICAL	0.46	0.49	-6.50	0.82	0.67	22.39
124. MECHANICS	0.47	0.47	0.43	0.48	0.47	1.55
125. ROBOTICS	0.49	0.48	1.18	0.50	0.88	-43.26
126. INSTRUMENTS & INSTRUMENTATION	0.49	0.49	0.69	0.61	0.85	-28.82
127. IMAGING SC. & PHOTOGRAPHIC TECH.	0.50	0.50	-0.84	1.00	1.35	-26.38
128. ENERGY & FUELS	0.49	0.50	-2.05	1.04	1.02	1.75
129. NUCLEAR SCIENCE & TECHNOLOGY	0.48	0.50	-4.53	0.75	1.07	-29.67
130. ENGINEERING, PETROLEUM	0.69	0.68	0.51	1.10	4.73	-76.71
131. AUTOMATION & CONTROL SYSTEMS	0.50	0.51	-2.43	1.20	1.09	10.07

132. ENGINEERING, MULTIDISCIPLINARY	0.53	0.55	-3.84	1.15	0.96	19.86
133. ERGONOMICS	0.42	0.45	-5.28	0.35	0.32	10.78
134. OPERATIONS RES. & MANAG. SCIENC	0.46	0.46	0.26	0.71	0.67	5.72

### ***XIII. MATERIALS SCIENCE***

135. MATERIALS SCIENCE, BIOMATERIALS	0.39	0.38	2.65	0.27	0.29	-5.36
136. MATERIALS SCIENCE, CERAMICS	0.54	0.52	3.49	0.48	0.52	-6.53
137. MAT. SC., CHARAC. & TESTING	0.60	0.62	-3.38	1.79	1.85	-3.56
138. MAT. SC., COATINGS & FILMS	0.44	0.44	-0.62	0.35	0.39	-10.16
139. MATERIALS SCIENCE, COMPOSITES	0.51	0.47	8.32	0.66	0.76	-12.99
140. MATERIALS SCIENCE, PAPER & WOOD	0.51	0.54	-6.02	0.55	0.46	20.30
141. MATERIALS SCIENCE, TEXTILES	0.52	0.53	-1.32	0.90	0.62	44.15
142. METALLURGY & METALL. ENGIN.	0.52	0.54	-3.64	1.21	1.57	-23.01
143. NANOSCIENCE & NANOTECHNOLOGY	0.44	0.45	-2.46	1.25	1.14	9.28

### ***XIV. GEOSCIENCES***

144. GEOCHEMISTRY & GEOPHYSICS	0.42	0.44	-2.86	0.69	0.61	12.97
145. GEOGRAPHY, PHYSICAL	0.40	0.40	-1.02	0.32	0.28	15.07
146. GEOLOGY	0.43	0.42	2.72	0.36	0.31	14.13
147. ENGINEERING, GEOLOGICAL	0.44	0.43	1.85	0.47	0.50	-4.51
148. PALEONTOLOGY	0.46	0.45	3.83	0.37	0.51	-26.92
149. REMOTE SENSING	0.43	0.43	1.13	0.80	0.75	6.31
150. OCEANOGRAPHY	0.42	0.40	2.91	0.26	0.31	-17.67
151. ENGINEERING, OCEAN	0.52	0.56	-7.70	1.18	1.23	-3.75
152. METEOROLOGY & ATMOSPHER. SCS.	0.44	0.42	5.09	0.62	0.54	14.05
153. ENGINEERING, AEROSPACE	0.55	0.56	-0.58	0.55	0.53	4.26
154. MINERALOGY	0.43	0.42	2.28	0.50	0.53	-5.03
155. MINING & MINERAL PROCESSING	0.52	0.57	-8.64	1.26	1.98	-36.19

### ***XV. AGRICULT. & ENVIRONMENT***

156. AGRICULTURAL ENGINEERING	0.42	0.45	-7.23	0.39	0.28	38.01
157. AGRICULTURE, MULTIDISCIPLINARY	0.50	0.53	-5.65	0.54	1.04	-47.82
158. AGRONOMY	0.47	0.48	-1.29	0.44	0.48	-7.77
159. LIMNOLOGY	0.41	0.43	-5.15	0.29	0.26	14.33
160. SOIL SCIENCE	0.43	0.43	0.20	0.26	0.22	22.23
161. BIODIVERSITY CONSERVATION	0.46	0.46	-0.43	0.49	0.69	-29.55
162. ENVIRONMENTAL SCIENCES	0.43	0.43	-0.67	0.57	0.57	0.80
163. ENVIRONMENTAL STUDIES	0.41	0.43	-3.58	0.53	0.49	8.73
164. FOOD SCIENCE & TECHNOLOGY	0.43	0.44	-1.78	0.40	0.46	-12.61
165. NUTRITION & DIETETICS	0.44	0.44	0.37	0.57	0.52	8.71
166. AGRIC., DAIRY & ANIMAL SCIENCE	0.49	0.51	-3.37	0.49	0.44	12.53
167. HORTICULTURE	0.46	0.45	0.73	0.51	0.61	-16.13

### ***XVI. BIOLOGY***

#### ***(ORGANISMIC AND SUPRAORG. LEVEL)***

168. ORNITHOLOGY	0.41	0.41	0.21	1.52	1.54	-1.03
169. ZOOLOGY	0.44	0.42	4.32	0.39	0.60	-35.05
170. ENTOMOLOGY	0.44	0.47	-6.07	0.41	0.33	24.92
171. WATER RESOURCES	0.44	0.45	-1.86	0.33	0.32	5.74
172. FISHERIES	0.39	0.40	-2.28	0.24	0.30	-19.32
173. MARINE & FRESHWATER BIOLOGY	0.37	0.39	-6.71	0.25	0.22	12.61
174. MICROBIOLOGY	0.38	0.39	-2.74	0.44	0.35	28.74
175. PARASITOLOGY	0.39	0.39	0.95	0.41	0.43	-5.35
176. VIROLOGY	0.36	0.35	1.30	0.33	0.29	13.73



177. FORESTRY	0.41	0.40	0.12	0.42	0.38	10.94
178. MYCOLOGY	0.46	0.48	-2.56	0.89	0.75	19.11
179. PLANT SCIENCES	0.42	0.45	-6.36	0.91	0.70	29.74
180. PURE AND APPLIED ECOLOGY	0.40	0.40	-0.55	0.35	0.35	-0.52
181. VETERINARY SCIENCES	0.50	0.51	-1.02	0.56	0.67	-16.02

#### ***XVII. MULTIDISCIPLINARY***

182. MULTIDISCIPLINARY SCIENCES	0.55	0.55	-0.81	2.15	2.16	-0.69
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#### ***XVIII. RESIDUAL SUB-FIELDS***

183. MATERIALS SCIENCE, MULT.	0.48	0.48	0.49	1.29	1.50	-13.88
184. CRYSTALLOGRAPHY	0.48	0.47	2.87	17.67	17.20	2.73
185. GEOSCIENCES, MULT.	0.44	0.46	-3.61	0.56	0.44	26.89
186. MED., RES. & EXPERIMENTAL	0.48	0.51	-5.31	2.97	3.51	-15.19

#### ***XIX. SOCIAL SCIENCES, GENERAL***

187. CRIMINOLOGY & PENOLOGY	0.51	0.52	-1.14	0.41	0.44	-5.40
188. LAW	0.49	0.48	3.13	0.79	0.88	-9.87
189. POLITICAL SCIENCE	0.56	0.56	0.37	0.95	1.05	-8.99
190. PUBLIC ADMINISTRATION	0.50	0.49	0.37	0.50	0.52	-3.94
191. ETHNIC STUDIES	0.57	0.53	6.47	1.13	2.32	-51.22
192. FAMILY STUDIES	0.45	0.44	2.22	0.45	0.63	-28.40
193. SOCIAL ISSUES	0.52	0.54	-2.75	0.85	1.06	-19.25
194. SOCIAL WORK	0.44	0.47	-7.58	0.49	0.34	44.84
195. SOCIOLOGY	0.53	0.54	-2.90	0.87	1.00	-13.54
196. WOMEN'S STUDIES	0.47	0.54	-12.20	0.86	0.64	32.95
197. EDUCATION & EDUCATIONAL RES.	0.52	0.49	5.59	0.74	1.22	-39.01
198. EDUCATION, SPECIAL	0.45	0.44	2.62	0.35	0.50	-29.22
199. AREA STUDIES	0.52	0.54	-2.83	0.70	0.60	16.21
200. GEOGRAPHY	0.43	0.45	-4.71	0.75	0.78	-3.94
201. PLANNING & DEVELOPMENT	0.48	0.48	-1.51	0.58	0.50	16.32
202. TRANSPORTATION	0.41	0.48	-14.72	0.37	0.25	46.05
2003 URBAN STUDIES	0.46	0.47	-1.40	0.51	0.48	7.24
204. ETHICS	0.49	0.51	-2.88	0.42	0.75	-43.51
205. MEDICAL ETHICS	0.43	0.43	0.37	0.39	0.40	-2.18
206. ANTHROPOLOGY	0.51	0.51	-0.21	0.48	0.73	-33.99
207. COMMUNICATION	0.47	0.47	-0.13	0.39	0.36	6.95
208. DEMOGRAPHY	0.43	0.44	-2.58	1.08	0.95	13.94
209. HISTORY OF SOCIAL SCIENCES	0.48	0.49	-2.34	0.50	0.48	4.50
210. INFORMATION SC. & LIBRARY SC.	0.54	0.57	-4.57	1.60	1.01	58.44
211. INTERNATIONAL RELATIONS	0.55	0.55	0.88	1.93	2.30	-16.12
212. LINGUISTICS	0.47	0.48	-1.18	0.42	0.48	-11.47
213. SOCIAL SCIENCES, INTERD.	0.52	0.50	4.35	0.60	1.09	-45.34

#### ***XX. ECONOMICS & BUSINESS***

214. AGRICULTURAL ECONOMICS & POLI	0.45	0.45	0.28	0.36	0.36	-1.94
215. ECONOMICS	0.48	0.50	-3.38	1.17	1.24	-5.40
216. INDUSTRIAL RELATIONS & LABOR	0.47	0.48	-2.18	0.50	0.47	6.79
217. BUSINESS	0.46	0.49	-4.92	0.82	0.55	49.08
218. BUSINESS, FINANCE	0.50	0.51	-1.52	0.96	1.05	-8.89
219. MANAGEMENT	0.48	0.47	3.10	0.75	1.02	-26.34

<b>Mean Value By Category</b>	0.46	0.46		1.12	1.10	
<b>Standard Deviation</b>	0.05	0.06		2.44	2.20	
<b>Coefficient of Variation</b>	0.11	0.12		2.17	2.00	

**Table C.I. High impact Indicators for the Original and Normalized Distributions at the Discipline Level According to the Multiplicative and the Fractional Strategies**

	Original Distribution:			Normalized Distribution:		
	Mult. (1)	Frac. (2)	(3) = (1) – (2) In %	Mult. (4)	Frac. (5)	(6) = (4) – (5) In %
<b><u>DISCIPLINES</u></b>						
D1. Multidisciplinary Biology	0.53	0.58	-9.06	0.56	0.58	-2.83
D2. Bioch., Biophysics & Molecular Biology	1.19	1.01	18.04	1.37	1.14	20.28
D3. Cell Biology	0.92	0.90	2.66	0.92	0.90	2.66
D4. Genetics & Development Biology	0.95	0.98	-3.05	0.89	1.09	-18.69
D5. Anatomy & Pathology	0.81	0.68	19.75	0.72	0.64	12.69
D6. Biomaterials & Bioengineering	1.98	1.70	16.52	1.72	1.48	16.48
D7. Experimental & Laboratory Medicine	0.68	0.79	-14.47	0.67	0.69	-1.92
D8. Pharmacology & Toxicology	0.52	0.57	-8.66	0.55	0.49	12.07
D9. Physiology	0.23	0.21	12.01	0.23	0.21	12.01
D10. Cardiovascular & Respiratory Medicine	0.94	0.84	11.74	0.98	0.85	14.99
D11. Endocrinology & Metabolism	0.61	0.63	-2.73	0.61	0.63	-2.73
D12. General & Internal Medicine	8.38	8.29	1.04	4.61	5.06	-8.90
D13. Hematology & Oncology	0.93	0.96	-3.58	0.88	0.94	-6.39
D14. Immunology	0.92	0.83	9.70	0.83	0.66	24.51
D15. Age & Gender Related Medicine	0.42	0.36	18.20	0.38	0.42	-9.87
D16. Dentistry, Oral Surgery	0.37	0.37	-1.34	0.37	0.37	-1.34
D17. Dermatology & Urogenital System	0.72	0.79	-8.07	0.63	0.67	-5.96
D18. Ophthalmology & Otorhinolaryngology	0.66	0.71	-6.99	0.49	0.57	-14.06
D19. Integrative & Complementary Medicine	0.30	0.54	-44.79	0.30	0.54	-44.79
D20. Psychiatry & Neurology	0.74	0.70	5.82	0.70	0.74	-4.84
D21. Radiology & Nuclear Medicine	0.82	0.64	29.45	0.82	0.64	29.45
D22. Rheumatology & Orthopedics	0.73	0.68	6.84	0.50	0.50	0.19
D23. Surgery	1.32	1.05	24.79	0.70	0.77	-8.79
D24. Pediatrics	0.71	0.78	-9.01	0.71	0.78	-9.01
D25. Health Sciences	0.59	0.62	-4.86	0.47	0.48	-2.11
D26. Other Clinical Medicine	1.14	0.85	33.97	1.04	0.81	27.15
D27. Neurosciences & Psychopharmacology	0.57	0.63	-8.44	0.59	0.64	-7.22
D28. Psychology & Behavioral Sciences	0.51	0.67	-24.14	0.64	0.78	-18.18
D29. Multidisciplinary Chemistry	1.01	1.07	-5.55	1.01	1.07	-5.55
D30. Analytical, Inorganic & Nuclear Chem.	0.55	0.58	-5.12	0.58	0.51	13.80
D31. Applied Chemistry & Chemical Eng.	0.60	0.52	15.89	0.48	0.66	-27.40

D32. Organic & Medicinal Chemistry	0.40	0.35	13.01	0.42	0.42	-0.35
D33. Physical Chemistry	0.51	0.49	5.50	0.52	0.50	3.01
D34. Polymer Science	0.71	0.58	23.07	0.71	0.58	23.07
D35. Multidisciplinary Physics	2.92	2.80	4.25	2.22	2.40	-7.25
D36. Applied Physics	1.09	0.99	10.96	1.01	0.94	7.55
D37. Atomic, Molecular & Chemical Physics	0.43	0.41	4.80	0.43	0.41	4.80
D38. Thermodynamics	0.54	0.51	5.93	0.54	0.51	5.93
D39. Mathematical & Theoretical Physics	0.71	0.73	-2.85	0.71	0.73	-2.85
D40. Particle & Nuclear Physics	3.24	3.53	-8.11	2.19	2.75	-20.24
D41. Physics of Solids, Fluids & Plasmas	0.79	0.75	5.46	0.98	0.92	6.33
D42. Astronomy & Astrophysics	0.97	1.03	-5.54	0.97	1.03	-5.54
D43. Applied Mathematics	5.94	2.52	136.31	3.46	2.54	36.32
D44. Pure mathematics	0.75	0.74	0.39	0.75	0.74	0.39
D45. Computer Science	5.38	5.51	-2.42	3.62	2.79	29.51
D46. Electrical & Electronic Engineering	1.36	1.25	8.98	1.46	1.37	7.15
D47. Civil Engineering	1.29	1.71	-24.27	0.62	0.72	-13.79
D48. Mechanical Engineering	0.54	0.49	11.08	0.54	0.53	0.59
D49. Instruments & Instrumentation	0.77	0.64	21.03	0.63	0.92	-31.02
D50. Fuel & Energy	0.85	1.22	-30.19	0.81	1.12	-28.12
D51. Other Engineering	1.04	0.88	18.64	0.97	0.94	3.29
D52. Materials Science	1.08	0.80	33.98	0.83	0.92	-10.08
D53. Geosciences & Technology	0.58	0.65	-10.86	0.58	0.59	-1.59
D54. Hydrology & Oceanography	0.31	0.37	-14.36	0.36	0.43	-16.76
D55. Meteorology, Atmos., Aero. Sc. & Tech	0.75	0.89	-15.97	0.56	0.60	-6.48
D56. Mineralogy & Petrology	0.57	0.82	-30.11	0.67	0.90	-25.54
D57. Agricultural Science & Technology	0.53	0.82	-35.59	0.61	0.58	4.49
D58. Plant & Soil Science & Technology	0.28	0.29	-1.74	0.26	0.23	12.44
D59. Environmental Science & Technology	0.66	0.66	-0.55	0.56	0.56	-0.16
D60. Food & Animal Science & Technology	0.73	0.73	0.75	0.47	0.53	-10.72
D61. Animal Sciences	0.43	0.50	-12.83	0.51	0.46	11.65
D62. Aquatic Sciences	0.28	0.26	9.20	0.26	0.26	-2.58
D63. Microbiology	0.41	0.40	2.51	0.40	0.36	9.82
D64. Plant Sciences	0.80	0.75	7.14	0.71	0.67	5.41
D65. Pure and Applied Ecology	0.35	0.35	-0.52	0.35	0.35	-0.52
D66. Veterinary Sciences	0.56	0.67	-16.02	0.56	0.67	-16.02
D67. Multidisciplinary	2.15	2.16	-0.69	2.15	2.16	-0.69
D68. Materials Science, Multidisciplinary	1.29	1.50	-13.88	1.29	1.50	-13.88
D69. Crystallography	17.67	17.20	2.73	17.67	17.20	2.73

D70. Geosciences, Multidisciplinary	0.56	0.44	26.89	0.56	0.44	26.89
D71. Medicine, Research & Experimental	2.97	3.51	-15.19	2.97	3.51	-15.19
D72. Law & Criminology	0.79	0.84	-6.57	0.76	0.81	-6.10
D73. Political Science & Public Administration	0.86	0.93	-7.76	0.92	0.92	-0.95
D74. Sociology & Other Social Studies	0.70	1.27	-44.96	0.85	0.79	7.45
D75. Education	0.80	0.63	27.08	0.67	1.15	-41.34
D76. Geography, Planning & Urban	0.59	0.60	-2.26	0.56	0.57	-1.93
D77. Ethics	0.48	0.44	9.66	0.44	0.72	-38.95
D78. Other Social Sciences	1.18	0.95	24.09	1.07	0.93	14.68
D79. Economics	1.14	1.16	-2.23	1.16	1.18	-1.87
D80. Business & Management	0.70	0.81	-12.90	0.85	0.90	-5.67

<b>Mean Value</b>	1.27	1.24	2.02	1.11	1.13	-1.46
<b>Standard Deviation</b>	2.24	2.14	22.26	2.02	1.97	15.83
<b>Coefficient of Variation</b>	1.76	1.73	11.02	1.82	1.75	-10.82

**Table C.II. High impact Indicators for the Original and Normalized Distributions at the Field Level According to the Multiplicative and the Fractional Strategies**

	Original Distribution:			Normalized Distribution:		
	Mult. (1)	Frac. (2)	(3)= (1) – (2) In %	Mult. (4)	Frac. (5)	(6)= (4) – (5) In %
<b><u>FIELDS</u></b>						
1. BIOSCIENCES	1.18	1.10	7.68	1.17	1.04	11.92
2. BIOMEDICAL RESEARCH	0.80	0.72	11.62	0.83	0.72	15.05
3. CLINICAL MEDICINE I	2.04	2.10	-3.01	1.79	1.92	-6.80
4. CLINICAL MEDICINE II	0.84	0.91	-7.57	0.63	0.63	-0.14
5. CLINICAL MEDICINE III	0.54	0.58	-6.07	0.52	0.51	1.85
6. NEUROS. AND BEHAVIORAL	0.78	0.74	5.30	0.60	0.68	-11.00
7. CHEMISTRY	0.68	0.72	-5.61	0.61	0.59	3.31
8. PHYSICS	1.55	1.80	-14.29	1.18	1.34	-12.01
9. SPACE SCIENCE	0.97	1.03	-5.54	0.97	1.03	-5.54
10. MATHEMATICS	6.28	2.24	180.83	2.38	1.55	53.32
11. COMPUTER SCIENCE	5.38	5.51	-2.42	3.62	2.79	29.51
12 ENGINEERING	1.12	0.94	20.08	0.86	1.00	-14.35
13. MATERIALS SCIENCES	1.08	0.80	33.98	0.83	0.92	-10.08
14. GEOSCIENCE	0.58	0.66	-12.05	0.56	0.57	-2.43
15. AGRIC. AND ENVIRONMENT	0.70	0.66	5.97	0.53	0.53	-1.13
16. PLANT AND ANIMAL SC.	0.57	0.68	-15.37	0.49	0.48	2.19
17. MULTIDICIPLINARY	2.15	2.16	-0.69	2.15	2.16	-0.69
18. RESIDUAL SUB-FIELDS	4.08	4.80	-15.11	3.05	3.69	-17.35
19. SOCIAL SCIENCES, GENERAL	0.63	1.03	-38.36	0.74	0.78	-5.33
20. ECONOMIC AND BUSSINESS	0.85	0.92	-8.01	1.03	1.05	-1.62
<b>Mean Value</b>	1.64	1.51	6.57	1.23	1.20	1.43
<b>Standard Deviation</b>	1.66	1.36	43.63	0.90	0.85	16.30
<b>Coefficient of Variation</b>	1.01	0.91	6.64	0.74	0.71	11.37

Table D.I. Number of Articles According to the Multiplicative and the Fractional Strategies. Sub-field Level

	SUB-FIELDS			DISCIPLINES			FIELDS		
	(1) Mult.	(2) Frac.	(3) = (1) – (2) In %	(4) Mult.	(5) Frac.	(6) = (4) – (5) In %	(7) Mult.	(8) Frac.	(9) = (7)– (8) In %
<b>I. BIOSCIENCES</b>							<b>367,568</b>	<b>282,233</b>	<b>30.2</b>
<b>D1. Multidisciplinary Biology</b>				<b>35,621.0</b>	<b>20,885.8</b>	<b>70.6</b>			
1. BIOLOGY	24,255.0	16,066.8	51.0						
2. BIOL., MISCELLANEOUS	418.0	168.5	148.1						
3. EVOL. BIOLOGY	10,948.0	4,650.6	135.4						
<b>D2. Bioch., Bioph., Mol. Biology</b>				<b>247,504.0</b>	<b>170,259.9</b>	<b>45.4</b>			
4. BIOCH. RES. METHODS	33,519.0	14,117.0	137.4						
5. BIOCH. & MOL. BIOLOGY	213,036.0	132,808.1	60.4						
6. BIOPHYSICS	48,733.0	23,334.8	108.8						
<b>D3 = 7. Cell Biology</b>	<b>83,279.0</b>	<b>44,686.2</b>	<b>86.4</b>	<b>83,279.0</b>	<b>44,686.2</b>	<b>86.4</b>			
<b>D4. Genetics &amp; Develop. Biol.</b>				<b>76,172.0</b>	<b>46,403.5</b>	<b>64.2</b>			
8. GENETICS & HEREDITY	61,490.0	35,869.1	71.4						
9. DEVELOP. BIOLOGY	16,689.0	10,534.4	58.4						
<b>II. BIOMED. RESEARCH</b>							<b>283,297</b>	<b>177,861</b>	<b>59.3</b>
<b>D5. Anatomy &amp; Pathology</b>				<b>34,480.0</b>	<b>22,585.0</b>	<b>52.7</b>			
10. PATHOLOGY	28,710.0	18,568.8	54.6						
11. ANAT. & MORPHOLOGY	5,996.0	4,016.2	49.3						
<b>D6. Biomat. &amp; Bioengineering</b>				<b>81,184.0</b>	<b>40,676.4</b>	<b>99.6</b>			
12. ENG., BIOMEDICAL	19,273.0	9,729.4	98.1						
13. BIOT. & APP. MICROB.	62,096.0	30,947.0	100.7						
<b>D7. Experimental &amp; Lab. Med.</b>				<b>14,050.0</b>	<b>10,012.3</b>	<b>40.3</b>			
14. MEDICAL LAB. TECH.	10,076.0	7,221.7	39.5						
15. MICROSCOPY	3,974.0	2,790.7	42.4						
<b>D8 Pharmac. &amp; Toxicology</b>				<b>122,806.0</b>	<b>79,929.1</b>	<b>53.6</b>			
16. PHARMAC. & PHARMACY	100,046.0	63,891.0	56.6						
17. TOXICOLOGY	30,590.0	16,038.1	90.7						
<b>D9 = 18. Physiology</b>	<b>43,122.0</b>	<b>24,658.8</b>	<b>74.9</b>	<b>43,122.0</b>	<b>24,658.8</b>	<b>74.9</b>			
<b>III. CLIN. MED. I (INT.)</b>							<b>453,611</b>	<b>362,743</b>	<b>25.0</b>
<b>D10. Cardio. &amp; Resp. Med.</b>				<b>72,152.0</b>	<b>52,970.6</b>	<b>36.2</b>			
19. CARD. & CARDIOV. SYS.	54,761.0	36,662.3	49.4						
20. RESPIRATORY SYSTEM	28,225.0	16,308.3	73.1						
<b>D11 = 21. Endoc. &amp; Metabol.</b>	<b>48,325.0</b>	<b>38,273.4</b>	<b>26.3</b>	<b>48,325.0</b>	<b>38,273.4</b>	<b>26.3</b>			
<b>D12. General &amp; Internal Med.</b>				<b>137,105.0</b>	<b>115,766.3</b>	<b>18.4</b>			
22. ANESTHESIOLOGY	16,677.0	13,774.5	21.1						
23. CRITICAL CARE MED.	13,106.0	7,728.6	69.6						
24. EMERGENCY MEDICINE	6,627.0	4,774.7	38.8						
25. GASTROENT. & HEPAT.	34,796.0	28,860.8	20.6						
26. MED., GENERAL & INT.	61,992.0	57,467.4	7.9						
27. TROPICAL MEDICINE	6,793.0	3,160.3	115.0						
<b>D13. Hematology &amp; Oncology</b>				<b>115,186.0</b>	<b>87,870.2</b>	<b>31.1</b>			
28. HEMATOLOGY	41,664.0	27,187.2	53.2						
29. ONCOLOGY	80,504.0	60,683.0	32.7						
<b>D14. Immunology</b>				<b>99,892.0</b>	<b>67,866.7</b>	<b>47.2</b>			
30. ALLERGY	8,979.0	4,913.1	82.8						
31. IMMUNOLOGY	81,367.0	44,920.0	81.1						
32. INFECTIOUS DISEASES	31,984.0	18,033.6	77.4						
<b>IV. CLIN. MED. II (NON-INT.)</b>							<b>503,076</b>	<b>403,788</b>	<b>24.6</b>
<b>D15. Age &amp; Gender Rel. Med.</b>				<b>54,299.0</b>	<b>42,444.8</b>	<b>27.9</b>			
33. GER. & GERONTOLOGY	9,333.0	5,372.4	73.7						

34. OBST. & GYNECOLOGY	32,152.0	22,939.1	40.2			
35. ANDROLOGY	1,419.0	1,360.5	4.3			
36. REPROD. BIOLOGY	16,586.0	9,134.9	81.6			
37. GERONTOLOGY	6,795.0	3,637.9	86.8			
<b>D16 = 38. Dentistry</b>	20,745.0	18,442.5	12.5	<b>20,745.0</b>	<b>18,442.5</b>	<b>12.5</b>
<b>D17. Dermat. &amp; Uro. System</b>				<b>54,441.0</b>	<b>47,727.8</b>	<b>14.1</b>
39. DERMATOLOGY	21,105.0	17,805.6	18.5			
40. UROLOGY & NEPHR.	33,336.0	29,922.2	11.4			
<b>D18. Ophthalm. &amp; Otorhin.</b>				<b>43,313.0</b>	<b>36,271.7</b>	<b>19.4</b>
41. OTORHINOLARYNG.	17,293.0	13,411.2	28.9			
42. OPHTHALMOLOGY	26,020.0	22,860.5	13.8			
<b>D19 = 43 Int. &amp; Compl. Med.</b>	2,425.0	1,346.8	80.1	<b>2,425.0</b>	<b>1,346.8</b>	<b>80.1</b>
<b>D20. Psychiatry &amp; Neurology</b>				<b>100,249.0</b>	<b>63,031.6</b>	<b>59.0</b>
44. CLINICAL NEUROLOGY	66,351.0	38,364.8	72.9			
45. PSYCHIATRY	43,084.0	24,666.8	74.7			
<b>D21 = 46. Rad, Nuc. Md. &amp; Im.</b>	53,889.0	38,208.1	41.0	<b>53,889.0</b>	<b>38,208.1</b>	<b>41.0</b>
<b>D22. Rheumat. &amp; Orthopedics</b>				<b>50,915.0</b>	<b>37,313.8</b>	<b>36.5</b>
47. ORTHOPEDICS	23,943.0	14,531.3	64.8			
48. RHEUMATOLOGY	10,558.0	10,260.5	2.9			
49. SPORT SCIENCES	20,520.0	12,522.0	63.9			
<b>D23. Surgery</b>				<b>144,345.0</b>	<b>90,786.9</b>	<b>59.0</b>
50. SURGERY	103,479.0	61,453.1	68.4			
51. TRANSPLANTATION	21,054.0	7,892.8	166.8			
52. PER. VASCULAR DISEASE	36,397.0	21,441.1	69.8			
<b>D24 = 53. Pediatrics</b>	42,315.0	28,214.7	50.0	<b>42,315.0</b>	<b>28,214.7</b>	<b>50.0</b>
<b>V. CL MD III</b>						
					<b>103,951</b>	<b>71,245. 45.9</b>
<b>D25. Health Sciences</b>				<b>95,164.0</b>	<b>65,254.9</b>	<b>45.8</b>
54. HEALTH C. SC. & SERV.	13,947.0	6,449.6	116.2			
55. HEALTH POLICY & SERV.	8,748.0	3,954.8	121.2			
56. MEDICINE, LEGAL	4,152.0	3,289.6	26.2			
57. NURSING	8,769.0	7,654.3	14.6			
58. PUB, ENV. & OC. HEALTH	49,445.0	30,304.9	63.2			
59. REHABILITATION	13,725.0	8,129.0	68.8			
60. SUBSTANCE ABUSE	7,765.0	5,472.7	41.9			
<b>D26. Other Clinical Medicine</b>				<b>14,423.0</b>	<b>5,991.0</b>	<b>140.7</b>
61. EDUC., SC. DISCIPLINES	8,084.0	3,936.2	105.4			
62. MEDICAL INFORMATICS	6,339.0	2,054.8	208.5			
<b>VI. NEUROSC. &amp; BEHAV.</b>						
					<b>206,738</b>	<b>151,778 36.2</b>
<b>D27. Neurosc. &amp; Psychop.</b>				<b>113,316.0</b>	<b>75,484.1</b>	<b>50.1</b>
63. NEUROIMAGING	6,195.0	2,065.0	200.0			
64. NEUROSCIENCES	109,828.0	73,419.1	49.6			
<b>D28. Psychology &amp; Behav. Sc.</b>				<b>103,560.0</b>	<b>76,294.3</b>	<b>35.7</b>
65. BEHAVIORAL SCIENCES	14,495.0	5,784.0	150.6			
66. PSYCH., BIOLOGICAL	3,987.0	1,451.7	174.6			
67. PSYCHOLOGY	16,107.0	6,036.8	166.8			
68. PSYCHOLOGY, APPLIED	8,092.0	5,224.5	54.9			
69. PSYCHOLOGY, CLINICAL	17,770.0	11,673.0	52.2			
70. PSYCH., DEVELOPMENT.	10,034.0	6,452.8	55.5			
71. PSYCH., EDUCATIONAL	5,301.0	3,928.7	34.9			
72. PSYCH., EXPERIMENTAL	15,641.0	9,321.7	67.8			
73. PSYCH., MATHEMATICAL	1,751.0	726.9	140.9			
74. PSYCH., MULTIDISC.	18,505.0	13,495.8	37.1			
75. PSYCH., PSYCHOAN.	2,427.0	1,785.3	35.9			
76. PSYCHOLOGY, SOCIAL	9,704.0	7,912.3	22.6			
77. SOCIAL SC., BIOMEDICAL	6,099.0	2,500.8	143.9			
<b>VII. CHEMISTRY</b>						
					<b>523,436</b>	<b>419,755 24.7</b>
<b>D29 = 78. Chemistry, Multid.</b>	98,455.0	81,069.0	21.4	<b>98,455.0</b>	<b>81,069.0</b>	<b>21.4</b>

<b>D30. An, Inorg. &amp; Nuc. Chem.</b>				<b>113,422.0</b>	<b>77,709.1</b>	<b>46.0</b>		
79. CHEM., INORG. & NUCL.	48,897.0	34,672.5	41.0					
80. CHEM., ANALYTICAL	67,276.0	43,036.6	56.3					
<b>D31. Ap. Chem. &amp; Chem. Eng.</b>				<b>87,213.0</b>	<b>50,494.1</b>	<b>72.7</b>		
81. CHEMISTRY, APPLIED	33,898.0	14,255.4	137.8					
82. ENG., CHEMICAL	58,925.0	36,238.7	62.6					
<b>D32. Org. &amp; Med. Chemistry</b>				<b>96,565.0</b>	<b>73,679.2</b>	<b>31.1</b>		
83. CHEMISTRY, MEDICINAL	24,497.0	11,227.5	118.2					
84. CHEMISTRY, ORGANIC	77,824.0	62,451.7	24.6					
<b>D33. Physical Chemistry</b>				<b>145,221.0</b>	<b>90,339.8</b>	<b>60.7</b>		
85. CHEMISTRY, PHYSICAL	125,278.0	77,805.7	61.0					
86. ELECTROCHEMISTRY	19,943.0	12,534.1	59.1					
<b>D34 = 87. Polymer Science</b>	<b>55,805.0</b>	<b>46,468.1</b>	<b>20.1</b>	<b>55,805.0</b>	<b>46,468.1</b>	<b>20.1</b>		
<b>VIII. PHYSICS</b>							<b>509,283</b>	<b>402,914 26.4</b>
<b>D35. Multidisciplinary Physics</b>				<b>112,995.0</b>	<b>92,217.5</b>	<b>22.5</b>		
88. PHYSICS, MULTIDISCIPLIN	83,218.0	76,200.3	9.2					
89. SPECTROSCOPY	29,777.0	16,017.2	85.9					
<b>D36. Applied Physics</b>				<b>182,439.0</b>	<b>126,153.9</b>	<b>44.6</b>		
90. ACOUSTICS	14,507.0	8,815.3	64.6					
91. OPTICS	52,712.0	36,515.2	44.4					
92. PHYSICS, APPLIED	125,579.0	80,823.4	55.4					
<b>D37 = 93. Ph, At, Mol &amp; Chem.</b>	<b>60,873.0</b>	<b>35,666.4</b>	<b>70.7</b>	<b>60,873.0</b>	<b>35,666.4</b>	<b>70.7</b>		
<b>D38 = 94. Thermod. (Cl. Ph.)</b>	<b>17,406.0</b>	<b>6,511.9</b>	<b>167.3</b>	<b>17,406.0</b>	<b>6,511.9</b>	<b>167.3</b>		
<b>D39 = 95. Ph., Mathematical</b>	<b>33,755.0</b>	<b>18,236.6</b>	<b>85.1</b>	<b>33,755.0</b>	<b>18,236.6</b>	<b>85.1</b>		
<b>D40. Part. &amp; Nuclear Physics</b>				<b>56,595.0</b>	<b>38,245.3</b>	<b>48.0</b>		
96. PHYSICS, NUCLEAR	25,305.0	15,013.2	68.6					
97. PHYSICS, PART. & FIELDS	39,261.0	23,232.2	69.0					
<b>D41. Ph. of Sol., Fluids &amp; Plas.</b>				<b>130,754.0</b>	<b>85,883.2</b>	<b>52.2</b>		
98. PH., COND. MATTER	106,659.0	71,182.0	49.8					
99. PH. OF SOL., FLU. & PLAS.	24,095.0	14,701.3	63.9					
<b>IX. SPACE SCIENCES</b>							<b>59,717</b>	<b>50,038. 19.3</b>
<b>D42 = 100. Astron. &amp; Astroph.,</b>	<b>59,717.0</b>	<b>50,038.3</b>	<b>19.3</b>	<b>59,717.0</b>	<b>50,038.3</b>	<b>19.3</b>		
<b>X. MATHEMATICS</b>							<b>138,611</b>	<b>113,722 21.9</b>
<b>D43. Applied Mathematics</b>				<b>90,234.0</b>	<b>57,634.1</b>	<b>56.6</b>		
101. MATHEMAT., APPLIED	52,352.0	33,302.1	57.2					
102. STAT. & PROBABILITY	23,095.0	15,631.4	47.7					
103. MATH., INTERD. APPL.	17,363.0	6,624.7	162.1					
104. SOC. SC., MATH. METH.	5,198.0	2,076.0	150.4					
<b>D44 = 105. Pure Mathematics</b>	<b>64,657.0</b>	<b>56,088.7</b>	<b>15.3</b>	<b>64,657.0</b>	<b>56,088.7</b>	<b>15.3</b>		
<b>XI. COMPUTER SCIENCE</b>							<b>116,602</b>	<b>82,180. 41.9</b>
<b>D45. Comp. Sc. &amp; Inf. Tech.</b>				<b>116,602.0</b>	<b>82,180.6</b>	<b>41.9</b>		
106. COMP. SC, ARTIF. INTEL.	23,546.0	15,743.0	49.6					
107. COMP. SC., CYBERNET.	4,393.0	2,419.5	81.6					
108. COMP SC, HARD & ARCH	12,494.0	5,113.7	144.3					
109. COMP. SC., INF. SYSTEMS	20,554.0	10,269.6	100.1					
110. COMP. SC., INTERD. APP.	27,243.0	11,260.1	141.9					
111. COMP. SC., SOFT. ENG.	17,375.0	10,267.9	69.2					
112. COMP. SC, THEO. & MET.	32,877.0	24,658.1	33.3					
113. MATH & COMPUT. BIOL.	7,388.0	2,448.8	201.7					
<b>XII. ENGINEERING</b>							<b>351,185</b>	<b>234,586 49.7</b>
<b>D46. Electric. &amp; Electron. Eng.</b>				<b>121,171.0</b>	<b>78,048.5</b>	<b>55.3</b>		
114. ENG, ELECT. & ELECTR.	117,411.0	68,315.1	71.9					
115. TELECOMM.	19,724.0	9,733.4	102.6					
<b>D47. Civil Engineering</b>				<b>44,684.0</b>	<b>24,616.3</b>	<b>81.5</b>		
116. CONSTR & BUILD TECH	8,198.0	3,778.8	116.9					



117. ENGINEERING, CIVIL	21,077.0	10,069.2	109.3			
118. ENG., ENVIRONMENT.	19,986.0	7,846.2	154.7			
119. ENG., MARINE	403.0	192.5	109.4			
120. TRANSP. SC. & TECH.	5,882.0	2,729.7	115.5			
<b>D48. Mechanical Engineering</b>				<b>90,384.0</b>	<b>56,511.1</b>	<b>59.9</b>
121. ENG., INDUSTRIAL	12,809.0	5,064.3	152.9			
122. ENG., MANUFACT.	13,416.0	5,446.2	146.3			
123. ENG., MECHANICAL	37,597.0	21,400.4	75.7			
124. MECHANICS	42,797.0	22,867.0	87.2			
125. ROBOTICS	2,906.0	1,733.3	67.7			
<b>D49. Instr. &amp; Instrumentation</b>				<b>42,122.0</b>	<b>16,670.1</b>	<b>152.7</b>
126. INSTR. & INSTRUMENT.	37,550.0	14,482.9	159.3			
127. IMA. SC. & PHOT. TECH.	4,758.0	2,187.2	117.5			
<b>D50. Fuel &amp; Energy</b>				<b>60,693.0</b>	<b>30,809.1</b>	<b>97.0</b>
128. ENERGY & FUELS	23,855.0	10,616.4	124.7			
129. NUCL. SC. & TECH.	35,795.0	17,240.2	107.6			
130. ENG., PETROLEUM	6,289.0	2,952.5	113.0			
<b>D51. Other Engineering</b>				<b>54,321.0</b>	<b>27,931.6</b>	<b>94.5</b>
131. UT. & CONT. SYSTEMS	15,992.0	7,600.3	110.4			
132. ENG., MULTID.	20,244.0	9,204.3	119.9			
133. ERGONOMICS	3,029.0	1,116.1	171.4			
134. OP. RES. & MAN. SC.	18,431.0	10,010.8	84.1			
<b>XIII. MATERIALS SCIENC</b>						<b>124,554 76,871. 62.0</b>
<b>D52. Materials Science</b>				<b>124,554.0</b>	<b>76,871.8</b>	<b>62.0</b>
135. MAT. SC., BIOMAT.	6,559.0	3,054.0	114.8			
136. MAT. SC., CERAMICS	19,356.0	15,573.5	24.3			
137. MAT. SC., CHAR. & TEST.	6,194.0	4,311.8	43.7			
138. MAT. SC., COAT. & FILMS	21,987.0	8,682.5	153.2			
139. MATERIALS SC., COMP.	9,535.0	6,313.0	51.0			
140. MAT. SC., PA. & WOOD	6,033.0	5,083.0	18.7			
141. MATERIALS SC., TEXT.	4,634.0	2,972.2	55.9			
142. MET. & METALL. ENG.	38,465.0	23,850.3	61.3			
143. NAN. & NANOTECH.	19,165.0	7,031.4	172.6			
<b>XIV. GEOSCIENCES</b>						<b>114,694 87,718. 30.8</b>
<b>D53. Geosc. &amp; Technology</b>				<b>52,829.0</b>	<b>40,935.8</b>	<b>29.1</b>
144. GEOCH. & GEOPHYSICS	26,065.0	22,703.4	14.8			
145. GEOGRAPHY, PHYSICAL	8,772.0	3,530.8	148.4			
146. GEOLOGY	7,796.0	6,023.2	29.4			
147. ENG., GEOLOGICAL	4,624.0	2,148.6	115.2			
148. PALEONTOLOGY	6,596.0	4,670.9	41.2			
149. REMOTE SENSING	4,981.0	1,858.9	168.0			
<b>D54. Hydro. &amp; Oceanography</b>				<b>21,177.0</b>	<b>12,862.8</b>	<b>64.6</b>
150. OCEANOGRAPHY	18,972.0	11,274.9	68.3			
151. ENGINEERING, OCEAN	3,332.0	1,587.8	109.8			
<b>D55 Met, Atm, Aer, Sc. &amp; Tec.</b>				<b>36,255.0</b>	<b>26,574.7</b>	<b>36.4</b>
152. MET. & ATMOSP. SCS.	27,338.0	18,206.8	50.2			
153 ENG., AEROSPACE	11,574.0	8,367.9	38.3			
<b>D56. Mineralogy &amp; Petrology</b>				<b>12,380.0</b>	<b>7,345.0</b>	<b>68.5</b>
154. MINERALOGY	7,308.0	4,421.2	65.3			
155. MIN. & MINERAL PROC.	6,536.0	2,923.9	123.5			
<b>XV. AGRICULT. &amp; ENVIR</b>						<b>211,659 146,508 44.5</b>
<b>D57. Agricult. Sc. &amp; Tech.</b>				<b>41,971.0</b>	<b>26,176.8</b>	<b>60.3</b>
156. AGRICULT. ENG.	4,379.0	2,993.8	46.3			
157. AGRICULT., MULT.	14,593.0	9,441.0	54.6			
158. AGRONOMY	23,263.0	13,741.9	69.3			
<b>D58. Plant &amp; Soil Sc. &amp; Tech,</b>				<b>19,068.0</b>	<b>11,888.1</b>	<b>60.4</b>
159. LIMNOLOGY	5,479.0	2,164.7	153.1			

160. SOIL SCIENCE	13,589.0	9,723.4	39.8			
<b>D59. Environ. Sc. &amp; Tech.</b>				<b>80,971.0</b>	<b>43,255.5</b>	<b>87.2</b>
161. BIODIVERSITY CONS.	6,269.0	2,723.8	130.2			
162. ENVIRONMENTAL SC.	69,648.0	35,988.1	93.5			
163. ENVIRONMENTAL ST.	9,742.0	4,543.6	114.4			
<b>D60. Food &amp; An. Sc. &amp; Tech.</b>				<b>89,926.0</b>	<b>65,188.0</b>	<b>37.9</b>
164. FOOD SC. & TECH.	43,023.0	25,759.3	67.0			
165. NUT. & DIETETICS	21,575.0	15,688.7	37.5			
166. AGRIC., DAIRY & AN. SC.	21,564.0	17,354.7	24.3			
167. HORTICULTURE	10,014.0	6,385.3	56.8			
<b>XVI. BIOLOGY (ORG. AND SUPRAORG. LEVEL)</b>					<b>352,483</b>	<b>265,083 33.0</b>
<b>D61. Animal Sciences</b>				<b>56,863.0</b>	<b>44,142.4</b>	<b>28.8</b>
168. ORNITHOLOGY	4,334.0	4,289.0	1.0			
169. ZOOLOGY	33,428.0	23,322.0	43.3			
170. ENTOMOLOGY	19,138.0	16,531.3	15.8			
<b>D62. Aquatic Sciences,</b>				<b>64,479.0</b>	<b>39,687.7</b>	<b>62.5</b>
171. WATER RESOURCES	25,164.0	10,815.2	132.7			
172. FISHERIES	15,452.0	10,069.8	53.4			
173. MAR. & FRESHW. BIOL.	32,162.0	18,802.8	71.0			
<b>D63. Microbiology</b>				<b>86,206.0</b>	<b>60,748.1</b>	<b>41.9</b>
174. MICROBIOLOGY	55,648.0	36,780.8	51.3			
175. PARASITOLOGY	10,789.0	8,049.7	34.0			
176. VIROLOGY	20,499.0	15,917.7	28.8			
<b>D64. Plant Sciences</b>				<b>79,138.0</b>	<b>57,426.5</b>	<b>37.8</b>
177. FORESTRY	10,844.0	8,471.4	28.0			
178. MYCOLOGY	5,916.0	4,675.6	26.5			
179. PLANT SCIENCES	63,766.0	44,279.5	44.0			
<b>D65 = 180. Pure &amp; App. Eco.</b>	<b>39,963.0</b>	<b>22,831.8</b>	<b>75.0</b>	<b>39,963.0</b>	<b>22,831.8</b>	<b>75.0</b>
<b>D66 = 181. VETERINARY SC.</b>	<b>49,295.0</b>	<b>40,249.4</b>	<b>22.5</b>	<b>49,295.0</b>	<b>40,249.4</b>	<b>22.5</b>
<b>XVII. MULTIDISCIP.</b>					<b>25,369</b>	<b>23,327. 8.8</b>
<b>D67 = 182. MULTID. SC.</b>	<b>25,369.0</b>	<b>23,327.0</b>	<b>8.8</b>	<b>25,369.0</b>	<b>23,327.0</b>	<b>8.8</b>
<b>XVIII. RESID. SUB-FIELD</b>					<b>250,829</b>	<b>153,764 63.1</b>
<b>D68 = 183. MAT. SC., MULT.</b>	<b>134,872.0</b>	<b>73,800.0</b>	<b>82.8</b>	<b>134,872.0</b>	<b>73,800.0</b>	<b>82.8</b>
<b>D69 = 184. CRYSTALLOG.</b>	<b>28,300.0</b>	<b>24,369.6</b>	<b>16.1</b>	<b>28,300.0</b>	<b>24,369.6</b>	<b>16.1</b>
<b>D70 = 185. GEOSC., MULT.</b>	<b>45,048.0</b>	<b>29,276.5</b>	<b>53.9</b>	<b>45,048.0</b>	<b>29,276.5</b>	<b>53.9</b>
<b>D71 = 186. MED, RES &amp; EXP.</b>	<b>42,928.0</b>	<b>26,318.7</b>	<b>63.1</b>	<b>42,928.0</b>	<b>26,318.7</b>	<b>63.1</b>
<b>XIX. SOCIAL SC., GENERAL</b>					<b>122,271</b>	<b>97,064. 26.0</b>
<b>D72. Law &amp; Criminology</b>				<b>12,127.0</b>	<b>9,308.8</b>	<b>30.3</b>
187. CRIM. & PENOLOGY	3,117.0	2,243.8	38.9			
188. LAW	9,488.0	7,064.9	34.3			
<b>D73. Pol. Sc. &amp; Pub. Admin.</b>				<b>15,048.0</b>	<b>11,389.8</b>	<b>32.1</b>
189. POLITICAL SCIENCE	12,008.0	8,902.1	34.9			
190. PUB. ADMINISTRATION	3,430.0	2,487.7	37.9			
<b>D74. Sociol. &amp; Other Soc. Stud.</b>				<b>27,463.0</b>	<b>19,608.8</b>	<b>40.1</b>
191. ETHNIC STUDIES	786.0	476.8	64.8			
192. FAMILY STUDIES	5,018.0	2,610.3	92.2			
193. SOCIAL ISSUES	4,126.0	2,289.1	80.2			
194. SOCIAL WORK	4,795.0	3,261.5	47.0			
195. SOCIOLOGY	12,125.0	8,781.7	38.1			
196. WOMEN'S STUDIES	3,650.0	2,189.4	66.7			
<b>D75. Education</b>				<b>18,131.0</b>	<b>13,809.3</b>	<b>31.3</b>
197. EDUC. & EDUCAT. RES.	15,185.0	12,108.7	25.4			
198. EDUCATION, SPECIAL	2,946.0	1,700.6	73.2			
<b>D76. Geog., Planning &amp; Urban</b>				<b>19,053.0</b>	<b>12,777.3</b>	<b>49.1</b>
199. AREA STUDIES	3,273.0	2,664.9	22.8			

200. GEOGRAPHY	5,498.0	3,703.4	48.5						
201. PLANNING & DEVELOP.	5,835.0	3,291.3	77.3						
202. TRANSPORTATION	1,889.0	829.1	127.8						
2003 URBAN STUDIES	4,581.0	2,288.6	100.2						
<b>D77. Ethics</b>				<b>3,820.0</b>	<b>2,074.1</b>	<b>84.2</b>			
204. ETHICS	3,557.0	1,836.5	93.7						
205. MEDICAL ETHICS	931.0	237.6	291.9						
<b>D78. Other Social Sciences</b>				<b>41,671.0</b>	<b>28,096.1</b>	<b>48.3</b>			
206. ANTHROPOLOGY	6,217.0	4,490.2	38.5						
207. COMMUNICATION	4,766.0	3,249.2	46.7						
208. DEMOGRAPHY	2,061.0	1,452.2	41.9						
209. HISTORY OF SOCIAL SC.	1,297.0	694.5	86.8						
210. INFO. SC. & LIBRARY SC.	8,734.0	5,731.7	52.4						
211. INT. RELATIONS	6,124.0	3,949.2	55.1						
212. LINGUISTICS	5,499.0	3,207.5	71.4						
213. SOCIAL SC., INTERD.	8,563.0	5,321.8	60.9						
							<b>57,884</b>	<b>45,324</b>	<b>27.7</b>
<b>XX. ECON. &amp; BUSINESS</b>									
<b>D79. Economics</b>				<b>37,001.0</b>	<b>27,372.3</b>	<b>35.2</b>			
214. AGRIC. ECON. & POLICY	1,725.0	820.0	110.4						
215. ECONOMICS	35,452.0	24,989.8	41.9						
216. IND. RELAT. & LABOR	2,051.0	1,562.5	31.3						
<b>D80. Business &amp; Management</b>				<b>25,303.0</b>	<b>17,952.3</b>	<b>40.9</b>			
217. BUSINESS	9,329.0	5,815.2	60.4						
218. BUSINESS, FINANCE	6,162.0	4,336.9	42.1						
219. MANAGEMENT	13,314.0	7,800.2	70.7				<b>367,568</b>	<b>282,233</b>	<b>30.2</b>
<hr/>									
<b>ALL CATEGORIES</b>	<b>5,735,512</b>	<b>3,648,524</b>	<b>57.1</b>	<b>5,371,569</b>	<b>3,648,524</b>	<b>47.2</b>	<b>4,876,818</b>	<b>3,648,524</b>	<b>33.7</b>
<b>Mean Size</b>	26,180.4	16,659.9		67,144.6	45,606.5		243,840	182,426.2	
<b>Standard Deviation</b>	29,390.1	19,562.5		44,642.5	31,089.0		164,031.9	130,829.4	
<b>Coefficient of Variation</b>	1.12	1.17		0.66	0.68		0.567	0.72	

**Table D.II. Distribution of Articles By Category According to the Multiplicative and the Fractional Strategy: Sub-field Discipline, and Field Levels**

	SUB-FIELDS			DISCIPLINES			FIELDS		
	(10) Mult.	(11) Frac.	(12) (10) – (11)	(13) Mult.	(14) Frac.	(15) = (13)- (14)	(16) Mult.	(17) Frac.	(18) = (16)- (17)
<b>I. BIOSCIENCES</b>							<b>7.54</b>	<b>7.74</b>	<b>-2.57</b>
<b>D1. Multidisciplinary Biology</b>				<b>0.66</b>	<b>0.57</b>	<b>15.84</b>			
1. BIOLOGY	0.4	0.4	-3.9						
2. BIOL., MISCELLANEOUS	0.0	0.0	57.9						
3. EVOL. BIOLOGY	0.2	0.1	49.8						
<b>D2. Bioch., Biop., Mol. Biology</b>				<b>4.61</b>	<b>4.67</b>	<b>-1.26</b>			
4. BIOCH. RES. METHODS	0.6	0.4	51.1						
5. BIOCH. & MOL. BIOLOGY	3.7	3.6	2.1						
6. BIOPHYSICS	0.8	0.6	32.9						
<b>D3 = 7. Cell Biology</b>	1.5	1.2	18.6	<b>1.55</b>	<b>1.22</b>	<b>26.58</b>			
<b>D4. Genetics &amp; Develop. Biol.</b>				<b>1.42</b>	<b>1.27</b>	<b>11.50</b>			
8. GENETICS & HEREDITY	1.1	1.0	9.1						
9. DEVELOP. BIOLOGY	0.3	0.3	0.8						
<b>II. BIOMED. RESEARCH</b>							<b>5.81</b>	<b>4.87</b>	<b>19.16</b>
<b>D5. Anatomy &amp; Pathology</b>				<b>0.64</b>	<b>0.62</b>	<b>3.70</b>			
10. PATHOLOGY	0.5	0.5	-1.6						
11. ANAT. & MORPHOLOGY	0.1	0.1	-5.0						
<b>D6. Biomat. &amp; Bioengineering</b>				<b>1.51</b>	<b>1.11</b>	<b>35.56</b>			
12. ENG., BIOMEDICAL	0.3	0.3	26.1						
13. BIOT. & APP. MICROB.	1.1	0.8	27.7						
<b>D7. Experimental &amp; Lab. Med.</b>				<b>0.26</b>	<b>0.27</b>	<b>-4.69</b>			
14. MEDICAL LAB. TECH.	0.2	0.2	-11.2						
15. MICROSCOPY	0.1	0.1	-9.4						
<b>D8 Pharmac. &amp; Toxicology</b>				<b>2.29</b>	<b>2.19</b>	<b>4.36</b>			
16. PHARMAC. & PHARMACY	1.7	1.8	-0.4						
17. TOXICOLOGY	0.5	0.4	21.4						
<b>D9 = 18. Physiology</b>	0.8	0.7	11.3	<b>0.80</b>	<b>0.68</b>	<b>18.78</b>			
<b>III. CLIN. MED. I (INT.)</b>							<b>9.30</b>	<b>9.94</b>	<b>-6.45</b>
<b>D10. Cardiov. &amp; Resp. Med.</b>				<b>1.34</b>	<b>1.45</b>	<b>-7.48</b>			
19. CARD. & CARDIOV. SYS.	1.0	1.0	-5.0						
20. RESPIRATORY SYSTEM	0.5	0.4	10.1						
<b>D11 = 21. Endoc. &amp; Metabol.</b>	0.8	1.0	-19.7	<b>0.90</b>	<b>1.05</b>	<b>-14.24</b>			
<b>D12. General &amp; Internal Med.</b>				<b>2.55</b>	<b>3.17</b>	<b>-19.56</b>			
22. ANESTHESIOLOGY	0.3	0.4	-23.0						
23. CRITICAL CARE MED.	0.2	0.2	7.9						
24. EMERGENCY MEDICINE	0.1	0.1	-11.7						
25. GASTROENT. & HEPAT.	0.6	0.8	-23.3						
26. MED., GENERAL & INT.	1.1	1.6	-31.4						
27. TROPICAL MEDICINE	0.1	0.1	36.8						
<b>D13. Hematology &amp; Oncology</b>				<b>2.14</b>	<b>2.41</b>	<b>-10.96</b>			
28. HEMATOLOGY	0.7	0.7	-2.5						
29. ONCOLOGY	1.4	1.7	-15.6						
<b>D14. Immunology</b>				<b>1.86</b>	<b>1.86</b>	<b>-0.03</b>			

30. ALLERGY	0.2	0.1	16.3
31. IMMUNOLOGY	1.4	1.2	15.3
32. INFECTIOUS DISEASES	0.6	0.5	12.9

#### **IV. CLI. MD. II (NON-INT.)**

**10.32 11.07 -6.79**

<b>D15. Age &amp; Gender Rel. Med.</b>				<b>1.01</b>	<b>1.16</b>	<b>-13.11</b>
33. GER. & GERONTOLOGY	0.2	0.1	10.5			
34. OBST. & GYNECOLOGY	0.6	0.6	-10.8			
35. ANDROLOGY	0.0	0.0	-33.6			
36. REPROD. BIOLOGY	0.3	0.3	15.5			
37. GERONTOLOGY	0.1	0.1	18.9			
<b>D16 = 38. Dent., Oral Surgery</b>	0.4	0.5	-28.4	<b>0.39</b>	<b>0.51</b>	<b>-23.60</b>
<b>D17. Dermat. &amp; Uro. System</b>				<b>1.01</b>	<b>1.31</b>	<b>-22.52</b>
39. DERMATOLOGY	0.4	0.5	-24.6			
40. UROLOGY & NEPHR.	0.6	0.8	-29.1			
<b>D18. Ophthalm. &amp; Otorhin.</b>				<b>0.81</b>	<b>0.99</b>	<b>-18.89</b>
41. OTORHINOLARYNG.	0.3	0.4	-17.9			
42. OPHTHALMOLOGY	0.5	0.6	-27.6			
<b>D19 = 43 Int. &amp; Compl. Med.</b>	0.0	0.0	14.6	<b>0.05</b>	<b>0.04</b>	<b>22.30</b>
<b>D20. Psychiatry &amp; Neurology</b>				<b>1.87</b>	<b>1.73</b>	<b>8.03</b>
44. CLINICAL NEUROLOGY	1.2	1.1	10.1			
45. PSYCHIATRY	0.8	0.7	11.1			
<b>D21 = 46. Rad, Nuc. Md. &amp; Im.</b>	0.9	1.0	-10.2	<b>1.00</b>	<b>1.05</b>	<b>-4.20</b>
<b>D22. Rheumat. &amp; Orthopedics</b>				<b>0.95</b>	<b>1.02</b>	<b>-7.32</b>
47. ORTHOPEDICS	0.4	0.4	4.9			
48. RHEUMATOLOGY	0.2	0.3	-34.5			
49. SPORT SCIENCES	0.4	0.3	4.3			
<b>D23. Surgery</b>				<b>2.69</b>	<b>2.49</b>	<b>7.99</b>
50. SURGERY	1.8	1.7	7.2			
51. TRANSPLANTATION	0.4	0.2	69.7			
52. PER. VASCULAR DISEASE	0.6	0.6	8.0			
<b>D24 = 53. Pediatrics</b>	0.7	0.8	-4.6	<b>0.79</b>	<b>0.77</b>	<b>1.87</b>

#### **V. CL MD III (HE & OT SCS.)**

**2.13 1.95 9.16**

<b>D25. Health Sciences</b>				<b>1.77</b>	<b>1.79</b>	<b>-0.95</b>
54. HEALTH C. SC. & SERV.	0.2	0.2	37.6			
55. HEALTH POLICY & SERV.	0.2	0.1	40.8			
56. MEDICINE, LEGAL	0.1	0.1	-19.7			
57. NURSING	0.2	0.2	-27.1			
58. PUB, ENV. & OC. HEALTH	0.9	0.8	3.8			
59. REHABILITATION	0.2	0.2	7.4			
60. SUBSTANCE ABUSE	0.1	0.1	-9.7			
<b>D26. Other Clinical Medicine</b>				<b>0.27</b>	<b>0.16</b>	<b>63.52</b>
61. EDUC., SC. DISCIPLINES	0.1	0.1	30.7			
62. MEDICAL INFORMATICS	0.1	0.1	96.3			

#### **VI. NEUROSC. & BEHAV.**

**4.24 4.16 1.90**

<b>D27. Neurosc. &amp; Psychop.</b>				<b>2.11</b>	<b>2.07</b>	<b>1.97</b>
63. NEUROIMAGING	0.1	0.1	90.9			
64. NEUROSCIENCES	1.9	2.0	-4.8			
<b>D28. Psychology &amp; Behav. Sc.</b>				<b>1.93</b>	<b>2.09</b>	<b>-7.80</b>
65. BEHAVIORAL SCIENCES	0.3	0.2	59.5			
66. PSYCH., BIOLOGICAL	0.1	0.0	74.8			
67. PSYCHOLOGY	0.3	0.2	69.8			

68. PSYCHOLOGY, APPLIED	0.1	0.1	-1.4						
69. PSYCHOLOGY, CLINICAL	0.3	0.3	-3.1						
70. PSYCH., DEVELOPMENT.	0.2	0.2	-1.0						
71. PSYCH., EDUCATIONAL	0.1	0.1	-14.1						
72. PSYCH., EXPERIMENTAL	0.3	0.3	6.8						
73. PSYCH., MATHEMATICAL	0.0	0.0	53.3						
74. PSYCH., MULTIDISC.	0.3	0.4	-12.7						
75. PSYCH., PSYCHOAN.	0.0	0.0	-13.5						
76. PSYCHOLOGY, SOCIAL	0.2	0.2	-22.0						
77. SOCIAL SC., BIOMEDICAL	0.1	0.1	55.2						
<b>VII. CHEMISTRY</b>							<b>10.73</b>	<b>11.50</b>	<b>-6.71</b>
<b>D29 = 78. Chemistry, Multid.</b>	1.7	2.2	-22.7	<b>1.83</b>	<b>2.22</b>	<b>-17.51</b>			
<b>D30. An, Inorg. &amp; Nuc. Chem.</b>				<b>2.11</b>	<b>2.13</b>	<b>-0.86</b>			
79. CHEM., INORG. & NUCL.	0.9	1.0	-10.3						
80. CHEM., ANALYTICAL	1.2	1.2	-0.5						
<b>D31. Ap. Chem. &amp; Chem. Eng.</b>				<b>1.62</b>	<b>1.38</b>	<b>17.32</b>			
81. CHEMISTRY, APPLIED	0.6	0.4	51.3						
82. ENG., CHEMICAL	1.0	1.0	3.5						
<b>D32. Org. &amp; Med. Chemistry</b>				<b>1.80</b>	<b>2.02</b>	<b>-10.98</b>			
83. CHEMISTRY, MEDICINAL	0.4	0.3	38.8						
84. CHEMISTRY, ORGANIC	1.4	1.7	-20.7						
<b>D33. Physical Chemistry</b>				<b>2.70</b>	<b>2.48</b>	<b>9.19</b>			
85. CHEMISTRY, PHYSICAL	2.2	2.1	2.5						
86. ELECTROCHEMISTRY	0.3	0.3	1.2						
<b>D34 = 87. Polymer Science</b>	1.0	1.3	-23.6	<b>1.04</b>	<b>1.27</b>	<b>-18.43</b>			
<b>VIII. PHYSICS</b>							<b>10.44</b>	<b>11.04</b>	<b>-5.44</b>
<b>D35. Multidisciplinary Physics</b>				<b>2.10</b>	<b>2.53</b>	<b>-16.77</b>			
88. PHYSICS, MULTIDISCIPLINA	1.5	2.1	-30.5						
89. SPECTROSCOPY	0.5	0.4	18.3						
<b>D36. Applied Physics</b>				<b>3.40</b>	<b>3.46</b>	<b>-1.77</b>			
90. ACOUSTICS	0.3	0.2	4.7						
91. OPTICS	0.9	1.0	-8.1						
92. PHYSICS, APPLIED	2.2	2.2	-1.1						
<b>D37 = 93. Ph, At, Mol &amp; Chem.</b>	1.1	1.0	8.6	<b>1.13</b>	<b>0.98</b>	<b>15.93</b>			
<b>D38 = 94. Thermod. (Cl. Ph.)</b>	0.3	0.2	70.1	<b>0.32</b>	<b>0.18</b>	<b>81.55</b>			
<b>D39 = 95. Ph., Mathematical</b>	0.6	0.5	17.8	<b>0.63</b>	<b>0.50</b>	<b>25.72</b>			
<b>D40. Part. &amp; Nuclear Physics</b>				<b>1.05</b>	<b>1.05</b>	<b>0.51</b>			
96. PHYSICS, NUCLEAR	0.4	0.4	7.3						
97. PHYSICS, PART. & FIELDS	0.7	0.6	7.5						
<b>D41. Ph. of Sol., Fluids &amp; Plas.</b>				<b>2.43</b>	<b>2.35</b>	<b>3.41</b>			
98. PH., COND. MATTER	1.9	2.0	-4.6						
99. PH. OF SOL., FLU. & PLAS.	0.4	0.4	4.3						
<b>IX. SPACE SCIENCES</b>							<b>1.22</b>	<b>1.37</b>	<b>-10.72</b>
<b>D42 = 100. Astron. &amp; Astroph.,</b>	1.0	1.4	-24.1	<b>1.11</b>	<b>1.37</b>	<b>-18.94</b>			
<b>X. MATHEMATICS</b>							<b>2.84</b>	<b>3.12</b>	<b>-8.81</b>
<b>D43. Applied Mathematics</b>				<b>1.68</b>	<b>1.58</b>	<b>6.34</b>			
101. MATHEMAT., APPLIED	0.9	0.9	0.0						
102. STAT. & PROBABILITY	0.4	0.4	-6.0						
103. MATH., INTERD. APPL.	0.3	0.2	66.8						
104. SOC. SC., MATH. METH.	0.1	0.1	59.3						

<b>D44 = 105. Pure Mathematics</b>	1.1	1.5	-26.6	<b>1.20</b>	<b>1.54</b>	<b>-21.70</b>			
<b>XI. COMPUTER SCIENCE</b>							<b>2.39</b>	<b>2.25</b>	<b>6.15</b>
<b>D45. Comp. Sc. &amp; Inf. Tech.</b>				<b>2.17</b>	<b>2.25</b>	<b>-3.63</b>			
106. COMP. SC, ARTIF. INTEL.	0.4	0.4	-4.8						
107. COMP. SC., CYBERNET.	0.1	0.1	15.5						
108. COMP SC, HARD & ARCH	0.2	0.1	55.5						
109. COMP. SC., INF. SYSTEMS	0.4	0.3	27.4						
110. COMP. SC., INTERD. APP.	0.5	0.3	54.0						
111. COMP. SC., SOFT. ENG.	0.3	0.3	7.7						
112. COMP. SC, THEO. & MET.	0.6	0.7	-15.2						
113. MATH & COMPUT. BIOL.	0.1	0.1	92.0						
<b>XII. ENGINEERING</b>							<b>7.20</b>	<b>6.43</b>	<b>12.00</b>
<b>D46. Electric. &amp; Electron. Eng.</b>				<b>2.26</b>	<b>2.14</b>	<b>5.45</b>			
114. ENG, ELECT. & ELECTR.	2.0	1.9	9.4						
115. TELECOMM.	0.3	0.3	29.0						
<b>D47. Civil Engineering</b>				<b>0.83</b>	<b>0.67</b>	<b>23.29</b>			
116. CONSTR & BUILD TECH	0.1	0.1	38.1						
117. ENGINEERING, CIVIL	0.4	0.3	33.2						
118. ENG., ENVIRONMENT.	0.3	0.2	62.1						
119. ENG., MARINE	0.0	0.0	33.2						
120. TRANSP. SC. & TECH.	0.1	0.1	37.1						
<b>D48. Mechanical Engineering</b>				<b>1.68</b>	<b>1.55</b>	<b>8.64</b>			
121. ENG., INDUSTRIAL	0.2	0.1	61.0						
122. ENG., MANUFACT.	0.2	0.1	56.8						
123. ENG., MECHANICAL	0.7	0.6	11.8						
124. MECHANICS	0.7	0.6	19.1						
125. ROBOTICS	0.1	0.0	6.7						
<b>D49. Instr. &amp; Instrumentation</b>				<b>0.78</b>	<b>0.46</b>	<b>71.63</b>			
126. INSTR. & INSTRUMENT.	0.7	0.4	65.0						
127. IMA. SC. & PHOT. TECH.	0.1	0.1	38.4						
<b>D50. Fuel &amp; Energy</b>				<b>1.13</b>	<b>0.84</b>	<b>33.81</b>			
128. ENERGY & FUELS	0.4	0.3	43.0						
129. NUCL. SC. & TECH.	0.6	0.5	32.1						
130. ENG., PETROLEUM	0.1	0.1	35.5						
<b>D51. Other Engineering</b>				<b>1.01</b>	<b>0.77</b>	<b>32.10</b>			
131. UT. & CONT. SYSTEMS	0.3	0.2	33.9						
132. ENG., MULTID.	0.4	0.3	40.0						
133. ERGONOMICS	0.1	0.0	72.7						
134. OP. RES. & MAN. SC.	0.3	0.3	17.2						
<b>XIII. MATERIALS SCIENCE</b>							<b>2.55</b>	<b>2.11</b>	<b>21.22</b>
<b>D52. Materials Science</b>				<b>2.32</b>	<b>2.11</b>	<b>10.05</b>			
135. MAT. SC., BIOMAT.	0.1	0.1	36.7						
136. MAT. SC., CERAMICS	0.3	0.4	-20.9						
137. MAT. SC., CHAR. & TEST.	0.1	0.1	-8.6						
138. MAT. SC., COAT. & FILMS	0.4	0.2	61.1						
139. MATERIALS SC., COMP.	0.2	0.2	-3.9						
140. MAT. SC., PA. & WOOD	0.1	0.1	-24.5						
141. MATERIALS SC., TEXT.	0.1	0.1	-0.8						
142. MET. & METALL. ENG.	0.7	0.7	2.6						
143. NAN. & NANOTECH.	0.3	0.2	73.4						

<b>XIV. GEOSCIENCES</b>							<b>2.35</b>	<b>2.40</b>	<b>-2.18</b>
<b>D53. Geosc. &amp; Technology</b>				<b>0.98</b>	<b>1.12</b>	<b>-12.34</b>			
144. GEOCH. & GEOPHYSICS	0.5	0.6	-26.9						
145. GEOGRAPHY, PHYSICAL	0.2	0.1	58.1						
146. GEOLOGY	0.1	0.2	-17.6						
147. ENG., GEOLOGICAL	0.1	0.1	36.9						
148. PALEONTOLOGY	0.1	0.1	-10.1						
149. REMOTE SENSING	0.1	0.1	70.5						
<b>D54. Hydro. &amp; Oceanography</b>				<b>0.39</b>	<b>0.35</b>	<b>11.83</b>			
150. OCEANOGRAPHY	0.3	0.3	7.1						
151. ENGINEERING, OCEAN	0.1	0.0	33.5						
<b>D55 Met, Atm, Aer, Sc. &amp; Tec.</b>				<b>0.67</b>	<b>0.73</b>	<b>-7.34</b>			
152. MET. & ATMOSP. SCS.	0.5	0.5	-4.5						
153 ENG., AEROSPACE	0.2	0.2	-12.0						
<b>D56. Mineralogy &amp; Petrology</b>				<b>0.23</b>	<b>0.20</b>	<b>14.48</b>			
154. MINERALOGY	0.1	0.1	5.2						
155. MIN. & MINERAL PROC.	0.1	0.1	42.3						
<b>XV. AGRICULT. &amp; ENVIR.</b>							<b>4.34</b>	<b>4.02</b>	<b>8.08</b>
<b>D57. Agricult. Sc. &amp; Tech.</b>				<b>0.78</b>	<b>0.72</b>	<b>8.91</b>			
156. AGRICULT. ENG.	0.1	0.1	-6.9						
157. AGRICULT., MULT.	0.3	0.3	-1.6						
158. AGRONOMY	0.4	0.4	7.7						
<b>D58. Plant &amp; Soil Sc. &amp; Tech,</b>				<b>0.35</b>	<b>0.33</b>	<b>8.95</b>			
159. LIMNOLOGY	0.1	0.1	61.1						
160. SOIL SCIENCE	0.2	0.3	-11.1						
<b>D59. Environ. Sc. &amp; Tech.</b>				<b>1.51</b>	<b>1.19</b>	<b>27.15</b>			
161. BIODIVERSITY CONS.	0.1	0.1	46.5						
162. ENVIRONMENTAL SC.	1.2	1.0	23.2						
163. ENVIRONMENTAL ST.	0.2	0.1	36.4						
<b>D60. Food &amp; An. Sc. &amp; Tech.</b>				<b>1.67</b>	<b>1.79</b>	<b>-6.30</b>			
164. FOOD SC. & TECH.	0.8	0.7	6.3						
165. NUT. & DIETETICS	0.4	0.4	-12.5						
166. AGRIC., DAIRY & AN. SC.	0.4	0.5	-20.9						
167. HORTICULTURE	0.2	0.2	-0.2						
<b>XVI. BIOLOGY (ORG. AND SUPRAORG. LEVEL)</b>							<b>7.23</b>	<b>7.27</b>	<b>-0.52</b>
<b>D61. Animal Sciences</b>				<b>1.06</b>	<b>1.21</b>	<b>-12.50</b>			
168. ORNITHOLOGY	0.1	0.1	-35.7						
169. ZOOLOGY	0.6	0.6	-8.8						
170. ENTOMOLOGY	0.3	0.5	-26.3						
<b>D62. Aquatic Sciences,</b>				<b>1.20</b>	<b>1.09</b>	<b>10.35</b>			
171. WATER RESOURCES	0.4	0.3	48.1						
172. FISHERIES	0.3	0.3	-2.4						
173. MAR. & FRESHW. BIOL.	0.6	0.5	8.8						
<b>D63. Microbiology</b>				<b>1.60</b>	<b>1.67</b>	<b>-3.61</b>			
174. MICROBIOLOGY	1.0	1.0	-3.7						
175. PARASITOLOGY	0.2	0.2	-14.7						
176. VIROLOGY	0.4	0.4	-18.0						
<b>D64. Plant Sciences</b>				<b>1.47</b>	<b>1.57</b>	<b>-6.40</b>			
177. FORESTRY	0.2	0.2	-18.5						
178. MYCOLOGY	0.1	0.1	-19.5						
179. PLANT SCIENCES	1.1	1.2	-8.4						



<b>D65 = 180. Pure &amp; App. Eco.</b>	0.7	0.6	11.4	<b>0.74</b>	<b>0.63</b>	<b>18.89</b>			
<b>D66 = 181. VETERINARY SC.</b>	0.9	1.1	-22.1	<b>0.92</b>	<b>1.10</b>	<b>-16.81</b>			
<b>XVII. MULTIDISCIP.</b>							<b>0.52</b>	<b>0.64</b>	<b>-18.64</b>
<b>D67 = 182. MULTID. SC.</b>	0.4	0.6	-30.8	<b>0.47</b>	<b>0.64</b>	<b>-26.13</b>			
<b>XVIII. RESID. SUB-FIELDS</b>							<b>5.14</b>	<b>4.21</b>	<b>22.04</b>
<b>D68 = 183. MAT. SC., MULT.</b>	2.4	2.0	16.3	<b>2.51</b>	<b>2.02</b>	<b>24.13</b>			
<b>D69 = 184. CRYSTALLOG.</b>	0.5	0.7	-26.1	<b>0.53</b>	<b>0.67</b>	<b>-21.12</b>			
<b>D70 = 185. GEOSC., MULT.</b>	0.8	0.8	-2.1	<b>0.84</b>	<b>0.80</b>	<b>4.51</b>			
<b>D71 = 186. MED, RES &amp; EXP.</b>	0.7	0.7	3.8	<b>0.80</b>	<b>0.72</b>	<b>10.79</b>			
<b>XIX. SOCIAL SC., GENERAL</b>							<b>2.51</b>	<b>2.66</b>	<b>-5.76</b>
<b>D72. Law &amp; Criminology</b>				<b>0.23</b>	<b>0.26</b>	<b>-11.51</b>			
187. CRIM. & PENOLOGY	0.1	0.1	-11.6						
188. LAW	0.2	0.2	-14.5						
<b>D73. Pol. Sc. &amp; Pub. Admin.</b>				<b>0.28</b>	<b>0.31</b>	<b>-10.26</b>			
189. POLITICAL SCIENCE	0.2	0.2	-14.2						
190. PUB. ADMINISTRATION	0.1	0.1	-12.3						
<b>D74. Sociol. &amp; Other Soc. Stud.</b>				<b>0.51</b>	<b>0.54</b>	<b>-4.87</b>			
191. ETHNIC STUDIES	0.0	0.0	4.9						
192. FAMILY STUDIES	0.1	0.1	22.3						
193. SOCIAL ISSUES	0.1	0.1	14.7						
194. SOCIAL WORK	0.1	0.1	-6.4						
195. SOCIOLOGY	0.2	0.2	-12.1						
196. WOMEN'S STUDIES	0.1	0.1	6.1						
<b>D75. Education</b>				<b>0.34</b>	<b>0.38</b>	<b>-10.82</b>			
197. EDUC. & EDUCAT. RES.	0.3	0.3	-20.2						
198. EDUCATION, SPECIAL	0.1	0.0	10.2						
<b>D76. Geog., Planning &amp; Urban</b>				<b>0.35</b>	<b>0.35</b>	<b>1.28</b>			
199. AREA STUDIES	0.1	0.1	-21.8						
200. GEOGRAPHY	0.1	0.1	-5.5						
201. PLANNING & DEVELOP.	0.1	0.1	12.8						
202. TRANSPORTATION	0.0	0.0	45.0						
203 URBAN STUDIES	0.1	0.1	27.4						
<b>D77. Ethics</b>				<b>0.07</b>	<b>0.06</b>	<b>25.10</b>			
204. ETHICS	0.1	0.1	23.3						
205. MEDICAL ETHICS	0.0	0.0	149.4						
<b>D78. Other Social Sciences</b>				<b>0.78</b>	<b>0.77</b>	<b>0.74</b>			
206. ANTHROPOLOGY	0.1	0.1	-11.9						
207. COMMUNICATION	0.1	0.1	-6.7						
208. DEMOGRAPHY	0.0	0.0	-9.7						
209. HISTORY OF SOCIAL SC.	0.0	0.0	18.8						
210. INFO. SC. & LIBRARY SC.	0.2	0.2	-3.0						
211. INT. RELATIONS	0.1	0.1	-1.3						
212. LINGUISTICS	0.1	0.1	9.1						
213. SOCIAL SC., INTERD.	0.1	0.1	2.4						
<b>XX. ECON. &amp; BUSINESS</b>							<b>1.19</b>	<b>1.24</b>	<b>-4.46</b>
<b>D79. Economics</b>				<b>0.69</b>	<b>0.75</b>	<b>-8.18</b>			
214. AGRIC. ECON. & POLICY	0.0	0.0	33.9						
215. ECONOMICS	0.6	0.7	-9.7						
216. IND. RELAT. & LABOR	0.0	0.0	-16.5						
<b>D80. Business &amp; Management</b>				<b>0.47</b>	<b>0.49</b>	<b>-4.27</b>			

217. BUSINESS	0.2	0.2	2.1					
218. BUSINESS, FINANCE	0.1	0.1	-9.6					
219. MANAGEMENT	0.2	0.2	8.6					
<b>ALL CATEGORIES</b>	100.0	100.0	-	<b>100.0</b>	<b>100.0</b>	-	<b>100.0</b>	<b>100.0</b>

**Table E. Mean Citation Rates for the Original, Un-normalized Distributions at the Sub-field Level According to the Multiplicative and the Fractional Strategies**

	Multiplicative (1)	Fractional (2)	(3) = (1) – (2) In %
<b><i>I. BIOSCIENCES</i></b>			
1. BIOLOGY	7.50	7.09	5.68
2. BIOLOGY, MISCELLANEOUS	3.41	3.12	9.13
3. EVOLUTIONARY BIOLOGY	12.47	12.40	0.57
4. BIOCHEMICAL RESEARCH METHODS	9.18	9.04	1.58
5. BIOCHEMISTRY & MOLEC. BIOLOGY	16.34	17.33	-5.71
6. BIOPHYSICS	10.88	10.82	0.57
7. CELL BIOLOGY	21.43	21.47	-0.20
8. GENETICS & HEREDITY	15.80	15.79	0.03
9. DEVELOPMENTAL BIOLOGY	19.41	20.42	-4.92
<b><i>II. BIOMEDICAL RESEARCH</i></b>			
10. PATHOLOGY	8.88	9.93	-10.56
11. ANATOMY & MORPHOLOGY	5.69	5.34	6.64
12. ENGINEERING, BIOMEDICAL	6.76	6.68	1.25
13. BIOTECH. & APPLIED MICROB.	9.07	8.91	1.77
14. MEDICAL LABORATORY TECHNOLOG	6.08	6.48	-6.23
15. MICROSCOPY	6.18	6.06	1.99
16. PHARMACOLOGY & PHARMACY	8.04	8.37	-3.95
17. TOXICOLOGY	7.14	7.06	1.18
18. PHYSIOLOGY	10.42	10.76	-3.18
<b><i>III. CLINICAL MEDICINE I (INTERNAL)</i></b>			
19. CARDIAC & CARDIOVASCULAR SYSTEM	11.42	9.93	14.98
20. RESPIRATORY SYSTEM	10.09	10.00	0.88
21. ENDOCRINOLOGY & METABOLISM	12.83	13.57	-5.51
22. ANESTHESIOLOGY	6.79	6.74	0.63
23. CRITICAL CARE MEDICINE	10.74	11.26	-4.56
24. EMERGENCY MEDICINE	4.11	4.53	-9.33
25. GASTROENTGY. & HEPATOLOGY	10.51	10.98	-4.34
26. MEDICINE, GENERAL & INTERNAL	12.68	13.20	-3.92
27. TROPICAL MEDICINE	4.96	5.09	-2.59
28. HEMATOLOGY	16.50	15.59	5.85
29. ONCOLOGY	13.93	14.83	-6.07
30. ALLERGY	8.57	7.95	7.87
31. IMMUNOLOGY	14.02	16.67	-15.86
32. INFECTIOUS DISEASES	11.68	11.37	2.74
<b><i>IV. CLIN. MED. II (NON-INTERNAL)</i></b>			
33. GERIATRICS & GERONTOLOGY	7.94	7.52	5.52
34. OBSTETRICS & GYNECOLOGY	6.67	6.47	3.17
35. ANDROLOGY	5.54	5.62	-1.39
36. REPRODUCTIVE BIOLOGY	9.54	10.12	-5.70
37. GERONTOLOGY	7.14	6.69	6.77
38. DENTISTRY, ORAL SURGERY	5.21	5.18	0.54
39. DERMATOLOGY	5.90	6.11	-3.41
40. UROLOGY & NEPHROLOGY	9.14	9.22	-0.94
41. OTORHINOLARYNGOLOGY	4.31	3.91	10.19

42. OPHTHALMOLOGY	6.93	6.98	-0.63
43 INTEGRATIVE & COMPLRY. MED.	4.33	3.95	9.68
44. CLINICAL NEUROLOGY	9.29	9.59	-3.17
45. PSYCHIATRY	9.58	9.97	-3.97
46. RADIOLOGY, NUCLEAR MED. & IMAG	7.65	7.68	-0.42
47. ORTHOPEDICS	5.73	5.48	4.63
48. RHEUMATOLOGY	10.74	10.78	-0.37
49. SPORT SCIENCES	5.85	5.69	2.89
50. SURGERY	6.35	6.29	0.99
51. TRANSPLANTATION	6.76	6.69	1.14
52. PERIPHERAL VASCULAR DISEASE	15.50	13.45	15.19
53. PEDIATRICS	5.70	5.99	-4.90

#### ***V. CL MED. III (HEALTH & OTHER S***

54. HEALTH CARE SCS. & SERVICES	5.75	5.55	3.58
55. HEALTH POLICY & SERVICES	6.26	5.85	7.03
56. MEDICINE, LEGAL	4.33	4.39	-1.40
57. NURSING	2.99	2.93	1.97
58. PUBLIC, ENV. & OCCUP. HEALTH	7.07	7.42	-4.72
59. REHABILITATION	4.17	3.91	6.64
60. SUBSTANCE ABUSE	7.44	7.46	-0.32
61. EDUCATION, SCIENTIFIC DISC.	2.84	2.83	0.43
62. MEDICAL INFORMATICS	4.14	3.90	6.38

#### ***VI. NEUROSCIENCE & BEHAVIOR***

63. NEUROIMAGING	10.38	10.38	0.00
64. NEUROSCIENCES	13.05	14.10	-7.46
65. BEHAVIORAL SCIENCES	8.73	8.82	-1.07
66. PSYCHOLOGY, BIOLOGICAL	7.33	7.05	3.87
67. PSYCHOLOGY	7.73	7.57	2.20
68. PSYCHOLOGY, APPLIED	4.59	4.80	-4.35
69. PSYCHOLOGY, CLINICAL	7.34	6.86	7.06
70. PSYCHOLOGY, DEVELOPMENTAL	7.58	7.17	5.70
71. PSYCHOLOGY, EDUCATIONAL	5.08	4.65	9.19
72. PSYCHOLOGY, EXPERIMENTAL	7.38	6.77	8.98
73. PSYCHOLOGY, MATHEMATICAL	5.10	5.31	-4.10
74. PSYCHOLOGY, MULTIDISCIPLINARY	4.75	4.16	14.14
75. PSYCHOLOGY, PSYCHOANALYSIS	2.54	2.06	23.28
76. PSYCHOLOGY, SOCIAL	6.05	6.33	-4.45
77. SOCIAL SCIENCES, BIOMEDICAL	5.20	5.22	-0.23

#### ***VII. CHEMISTRY***

78. CHEMISTRY, MULTIDISCIPLINARY	8.59	8.91	-3.56
79. CHEM., INORGANIC & NUCLEAR	6.58	6.74	-2.27
80. CHEMISTRY, ANALYTICAL	7.36	7.63	-3.51
81. CHEMISTRY, APPLIED	5.43	4.55	19.31
82. ENGINEERING, CHEMICAL	4.23	4.00	5.74
83. CHEMISTRY, MEDICINAL	7.33	8.73	-16.05
84. CHEMISTRY, ORGANIC	7.91	7.95	-0.46
85. CHEMISTRY, PHYSICAL	7.73	7.71	0.34
86. ELECTROCHEMISTRY	7.45	6.85	8.68
87. POLYMER SCIENCE	6.11	6.35	-3.72

#### ***VIII. PHYSICS***

88. PHYSICS, MULTIDISCIPLINARY	8.21	8.55	-3.96
89. SPECTROSCOPY	5.66	5.42	4.46
90. ACOUSTICS	3.96	3.95	0.12
91. OPTICS	5.30	5.24	1.22
92. PHYSICS, APPLIED	5.68	6.44	-11.79
93. PHYSICS, ATOMIC, MOLECULAR & CHI	8.51	9.30	-8.49
94. THERMODYNAMICS (CLASS. PHY.)	3.36	3.27	2.90
95. PHYSICS, MATHEMATICAL	5.66	5.71	-0.84
96. PHYSICS, NUCLEAR	5.01	5.76	-13.03
97. PHYSICS, PARTICLES & FIELDS	9.01	10.28	-12.43
98. PHYSICS, CONDENSED MATTER	5.55	6.24	-11.00
99. PH. OF SOLIDS, FLUIDS & PLASMAS	7.02	6.84	2.58

#### ***IX. SPACE SCIENCES***

100. ASTRONOMY & ASTROPHYSICS	11.32	11.78	-3.95
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#### ***X. MATHEMATICS***

101. MATHEMATICS, APPLIED	2.64	2.69	-1.95
102. STATISTICS & PROBABILITY	4.48	3.47	29.08
103. MATHEMATICS, INTERDISC. APPL.	4.10	4.00	2.53
104. SOCIAL SCS., MATH. METHODS	4.07	3.93	3.55
105. PURE MATHEMATICS	1.95	1.94	0.34

#### ***XI. COMPUTER SCIENCE***

106. COMP. SC, ARTIFICIAL INTELL.	3.84	3.42	12.04
107. COMP. SCIENCE, CYBERNETICS	2.58	2.35	9.56
108. COMP SC., HARDWARE & ARCH.	3.06	2.71	13.08
109. COMP. SC., INFORMATION SYSTEMS	3.33	2.96	12.42
110. COMP. SC., INTERDIS. APPS.	4.50	3.89	15.81
111. COMP. SC., SOFTWARE ENG.	2.64	2.55	3.27
112. COMP. SC, THEOTY & METHODS	2.36	2.02	16.74
113. MATH. & COMPUT. BIOLOGY	8.45	7.28	16.07

#### ***XII. ENGINEERING***

114. ENG., ELECTRICAL & ELECTRONIC	3.52	3.36	4.78
115. TELECOMMUNICATIONS	2.76	2.56	7.78
116. CONSTR. & BUILDING TECH.	2.36	2.37	-0.45
117. ENGINEERING, CIVIL	2.33	2.12	9.92
118. ENGINEERING, ENVIRONMENTAL	6.40	6.79	-5.77
119. ENGINEERING, MARINE	0.98	1.02	-3.98
120. TRANSPORTATION SC. & TEC.	1.49	1.29	15.69
121. ENGINEERING, INDUSTRIAL	2.17	2.09	4.06
122. ENGINEERING, MANUFACTURING	2.36	2.32	1.63
123. ENGINEERING, MECHANICAL	2.80	2.53	10.53
124. MECHANICS	3.69	3.73	-1.23
125. ROBOTICS	2.50	2.19	14.09
126. INSTRUMENTS & INSTRUMENTATION	3.67	3.42	7.42
127. IMAGING SC. & PHOTOGRAPHIC TEC	5.24	4.12	27.22
128. ENERGY & FUELS	3.46	3.35	3.36
129. NUCLEAR SCIENCE & TEC.	3.17	2.65	19.66
130. ENGINEERING, PETROLEUM	1.12	0.98	13.90
131. UTOMATION & CONTROL SYSTEMS	2.83	2.68	5.61
132. ENGINEERING, MULTIDISCIPLINARY	2.66	2.44	9.14
133. ERGONOMICS	3.25	3.04	6.87

134. OPERATIONS RES. & MANAG. SCIENC	2.75	2.74	0.44
<b>XIII. MATERIALS SCIENCE</b>			
135. MATERIALS SCIENCE, BIOMATERIALS	9.40	9.67	-2.79
136. MATERIALS SCIENCE, CERAMICS	3.41	3.58	-4.65
137. MAT. SC., CHARAC. & TESTING	1.42	1.33	6.57
138. MAT. SC., COATINGS & FILMS	5.44	5.52	-1.40
139. MATERIALS SCIENCE, COMPOSITES	2.45	2.72	-10.03
140. MATS. SCIENCE, PAPER & WOOD	1.97	1.78	10.77
141. MATERIALS SCIENCE, TEXTILES	1.94	1.78	9.39
142. METALLURGY & METALL. ENGIN.	3.31	2.75	20.41
143. NANOSCIENCE & NANOTECH.	5.78	5.49	5.26
<b>XIV. GEOSCIENCES</b>			
144. GEOCHEMISTRY & GEOPHYSICS	7.13	7.33	-2.73
145. GEOGRAPHY, PHYSICAL	6.43	6.79	-5.37
146. GEOLOGY	5.71	6.31	-9.53
147. ENGINEERING, GEOLOGICAL	2.60	2.66	-2.24
148. PALEONTOLOGY	4.66	3.89	19.95
149. REMOTE SENSING	5.38	5.31	1.29
150. OCEANOGRAPHY	7.32	7.66	-4.47
151. ENGINEERING, OCEAN	2.71	2.55	5.96
152. METEOROLOGY & ATMOSPH. SCS.	7.72	9.00	-14.17
153 ENGINEERING, AEROSPACE	1.73	1.72	0.40
154. MINERALOGY	5.25	5.22	0.54
155. MINING & MINERAL PROCESSING	2.77	2.22	24.48
<b>XV. AGRICULT. &amp; ENVIRONMENT</b>			
156. AGRICULTURAL ENGINEERING	3.29	2.92	12.80
157. AGRICULTURE, MULTIDRY.	4.71	3.31	42.12
158. AGRONOMY	4.18	3.63	15.18
159. LIMNOLOGY	6.94	7.18	-3.37
160. SOIL SCIENCE	4.87	5.28	-7.76
161. BIODIVERSITY CONSERVATION	6.21	5.35	16.13
162. ENVIRONMENTAL SCIENCES	6.42	6.37	0.77
163. ENVIRONMENTAL STUDIES	3.48	3.31	4.89
164. FOOD SCIENCE & TECHNOLOGY	5.05	4.55	10.97
165. NUTRITION & DIETETICS	8.29	8.93	-7.13
166. AGRIC., DAIRY & ANIMAL SCIENCE	3.71	3.50	6.09
167. HORTICULTURE	4.44	3.25	36.66
<b>XVI. BIOLOGY</b>			
<b>(ORGANISMIC AND SUPRAORG. LEV</b>			
168. ORNITHOLOGY	4.12	4.14	-0.38
169. ZOOLOGY	5.41	4.78	13.13
170. ENTOMOLOGY	3.85	3.50	10.07
171. WATER RESOURCES	4.30	4.21	2.24
172. FISHERIES	5.11	4.59	11.30
173. MARINE & FRESHWATER BIOLOGY	5.99	5.60	6.92
174. MICROBIOLOGY	10.82	10.83	-0.12
175. PARASITOLOGY	5.97	6.05	-1.23
176. VIROLOGY	14.62	15.19	-3.79
177. FORESTRY	5.20	5.18	0.40
178. MYCOLOGY	5.01	4.34	15.30

179. PLANT SCIENCES	7.19	7.19	-0.02
180. PURE AND APPLIED ECOLOGY	8.33	8.39	-0.75
181. VETERINARY SCIENCES	3.62	3.13	15.76

***XVII. MULTIDISCIPLINARY***

182. MULTIDISCIPLINARY SCIENCES	2.99	2.99	0.06
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***XVIII. RESIDUAL SUB-FIELDS***

183. MATERIALS SCIENCE, MULT.	4.77	4.32	10.58
184. CRYSTALLOGRAPHY	4.17	3.78	10.44
185. GEOSCIENCES, MULT.	5.24	5.42	-3.35
186. MED., RES. & EXPERIMENTAL	13.35	12.21	9.39

***XIX. SOCIAL SCIENCES, GENERAL***

187. CRIMINOLOGY & PENOLOGY	3.46	3.48	-0.72
188. LAW	3.33	3.55	-6.09
189. POLITICAL SCIENCE	2.39	2.45	-2.20
190. PUBLIC ADMINISTRATION	2.47	2.50	-1.39
191. ETHNIC STUDIES	1.82	1.62	12.61
192. FAMILY STUDIES	4.22	3.95	6.80
193. SOCIAL ISSUES	2.53	2.53	0.01
194. SOCIAL WORK	2.73	2.38	15.07
195. SOCIOLOGY	3.02	3.00	0.48
196. WOMEN'S STUDIES	2.80	2.32	20.56
197. EDUCATION & EDUCATIONAL RES.	2.33	2.17	7.21
198. EDUCATION, SPECIAL	3.63	3.30	10.22
199. AREA STUDIES	1.33	1.25	6.61
200. GEOGRAPHY	4.18	4.08	2.28
201. PLANNING & DEVELOPMENT	3.10	2.98	3.77
202. TRANSPORTATION	3.45	2.81	22.76
2003 URBAN STUDIES	3.10	3.04	2.04
204. ETHICS	2.37	2.01	17.83
205. MEDICAL ETHICS	3.76	3.78	-0.45
206. ANTHROPOLOGY	2.99	2.63	13.81
207. COMMUNICATION	2.94	2.94	0.11
208. DEMOGRAPHY	4.23	4.07	3.84
209. HISTORY OF SOCIAL SCIENCES	1.41	1.37	2.86
210. INFORMATION SC. & LIBRARY SC.	2.82	2.35	20.26
211. INTERNATIONAL RELATIONS	2.24	2.38	-6.10
212. LINGUISTICS	4.23	3.68	14.73
213. SOCIAL SCIENCES, INTERD.	2.40	2.18	10.12

***XX. ECONOMICS & BUSINESS***

214. AGRICULTURAL ECONOMICS & POLI	2.56	2.58	-0.62
215. ECONOMICS	3.47	3.38	2.68
216. INDUSTRIAL RELATIONS & LABOR	3.17	3.03	4.86
217. BUSINESS	4.90	4.94	-0.83
218. BUSINESS, FINANCE	4.74	4.84	-1.97
219. MANAGEMENT	4.57	4.31	6.01

<b>Mean Value</b>	5.84	5.77	
<b>Standard Deviation</b>	3.46	3.62	
<b>Coefficient of Variation</b>	0.59	0.63	

### Appendix III. A Family of High- and Low-impact Indicators

Consider a discrete citation distribution of papers published in a given year, that is, consider an ordered, non-negative vector  $\mathbf{c} = (c_1, \dots, c_h, \dots, c_n)$  where  $c_1 \leq c_2 \leq \dots \leq c_n$  and  $c_i \geq 0$  is the number of citations received by the  $i$ -th article. Given a distribution  $\mathbf{c}$  and a positive CCL, classify as low- or high-impact articles all papers with citation  $c_i \leq \text{CCL}$ , or  $c_i > \text{CCL}$ . In this paper, the CCL is always fixed at the 80<sup>th</sup> percentile of the world citation distribution. To simplify the notation, we will omit in the sequel a reference for such fixed CCL. Thus, denote by  $n(\mathbf{c})$  the total number of articles in the distribution, and by  $l(\mathbf{c})$  and  $h(\mathbf{c}) = n(\mathbf{c}) - l(\mathbf{c})$  the number of low- and high-impact articles. A *low-impact index* is a real valued function  $L$  whose typical value  $L(\mathbf{c})$  indicates the low-impact level associated with distribution  $\mathbf{c}$ , while a *high-impact index* is a real valued function  $H$  whose typical value  $H(\mathbf{c})$  indicates the high-impact level associated with that distribution.

Given a citation distribution  $\mathbf{c}$  and a CCL, the Foster, Greer, and Thorbecke (FGT hereafter) family of low-impact indicators, originally introduced in Foster *et al.* (1984) for the measurement of economic poverty, is defined by:

$$L_\beta(\mathbf{c}) = [1/n(\mathbf{c})] \sum_{i=1}^{l(\mathbf{c})} (\Gamma_i)^\beta, 0 \leq \beta,$$

where  $\beta$  is a parameter identifying the members of the family, and  $\Gamma_i = \max \{(\text{CCL} - c_i)/\text{CCL}, 0\}$  is the *normalized low-impact gap* for any article with  $c_i$  citations. Note that  $\Gamma_i \geq 0$  for low-impact articles, while  $\Gamma_i = 0$  for high-impact articles. The class of FGT high-impact indicators is defined by

$$H_\beta(\mathbf{c}) = [1/n(\mathbf{c})] \sum_{i=l(\mathbf{c})+1}^{n(\mathbf{c})} (\Gamma_i^*)^\beta, 0 \leq \beta,$$

where  $\beta$  is again a parameter identifying the members of the family, and  $\Gamma_i^* = \max \{(c_i - \text{CCL})/\text{CCL}, 0\}$  is the *normalized high-impact gap*. Now  $\Gamma_i^* > 0$  for high-impact articles, while  $\Gamma_i^* = 0$  for low-impact articles. As explained in Albarrán *et al.* (2011b), both families are size- and scale-invariant.

It will be sufficient to understand the differences involved in these indicators for parameter values  $\beta = 0, 1$ , and 2. Firstly, note that the high- and low-impact indices obtained when  $\beta = 0$  coincide with the proportion of high- and low-impact papers:  $H_0(\mathbf{c}) = h(\mathbf{c})/n(\mathbf{c})$ , and  $L_0(\mathbf{c}) = l(\mathbf{c})/n(\mathbf{c})$ . It should be noted that the mere percentage of articles satisfying some interesting condition only captures what can be referred to as the *incidence* aspect of the phenomenon in question. In this sense, it can be said that  $H_0$  and  $L_0$  only capture the incidence aspect of the high- and low-impact phenomenon. Secondly, denote by  $\mu_H(\mathbf{c})$  and  $\mu_L(\mathbf{c})$  the MCR of high- and low-impact articles. It can be shown that

$$H_1(\mathbf{c}) = [1/n(\mathbf{c})] \sum_{i=l(\mathbf{c})+1}^{n(\mathbf{c})} \Gamma_i^* = H_0(\mathbf{c})H_1(\mathbf{c}),$$

and

$$L_1(\mathbf{c}) = [1/n(\mathbf{c})] [\sum_{i=1}^{l(\mathbf{c})} \Gamma_i] = L_0(\mathbf{c})L_1(\mathbf{c}),$$

where

$$H_1(\mathbf{c}) = [1/h(\mathbf{c})] \sum_{i=l(\mathbf{c})+1}^{n(\mathbf{c})} \Gamma_i^* = [\mu_H(\mathbf{c}) - \text{CCL}]/\text{CCL},$$

and

$$L_1(\mathbf{c}) = [1/l(\mathbf{c})] \sum_{i=1}^{l(\mathbf{c})} \Gamma_i = [\text{CCL} - \mu_L(\mathbf{c})]/\text{CCL}.$$

The indices  $H_1$  and  $L_1$  are said to be monotonic in the sense that one more citation among high-impact articles increases  $H_1$  and  $L_1$ . Therefore, it can be said that  $H_1$  and  $L_1$  capture both the incidence and the intensity of these phenomena. Thirdly, the high- and low-impact members of the FGT families obtained when  $\beta = 2$  can be expressed as:

$$H_2(\mathbf{c}) = H_0(\mathbf{c})\{[(H_1(\mathbf{c}))^2 + [1 - H_1(\mathbf{c})]^2 (C_H)^2]\}, \quad (1)$$

$$L_2(\mathbf{c}) = L_0(\mathbf{c})\{[(L_1(\mathbf{c}))^2 + [1 - L_1(\mathbf{c})]^2 (C_L)^2]\}, \quad (2)$$

where  $C_H$  and  $C_L$  are the coefficients of variation (that is, the ratio of the standard deviation over the mean) among the high- and low-impact articles, respectively. In so far as the coefficient of variation is a measure of citation inequality, the FGT indicators  $H_2$  and  $L_2$  defined in equations (1) and (2) simultaneously capture the incidence, the intensity, and the *citation inequality* aspects of the high- and low-impact phenomenon they measure (see Albarrán *et al.*, 2011b, for a full discussion of the properties possessed by the above indicators).

Since in this paper only indicators for parameter value  $\beta = 2$  will be computed, we will omit any further subscript in what follows. Thus, in the text the high- and low-impact indicators for  $\beta = 2$  are simply denoted as  $H$  and  $L$ , respectively.